

The glades of the Buffalo National River,
Arkansas

by

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Introduction

A glade is an opening with shallow soil and grassy or herbaceous vegetation or bare rock in an otherwise forested landscape. Glades are found as far east as Georgia and West Virginia (Burbanck and Platt 1964, Bartgis 1985) and as far south as Alabama and Texas (Harper 1920, Harper 1939, Whitehouse 1933), but the most numerous glade areas are found in Arkansas, Indiana, Kentucky, Missouri, and Tennessee (Nelson and Ladd 1983). This study of glades was conducted at the Buffalo National River area of northwestern Arkansas. The objectives were: 1) to locate and map glade communities within the National Park Service boundary; 2) to identify the plant species of these glades; and 3) to compare the vegetation of different glade communities using numerical analysis. In addition, I shall compare the results of this survey with those from other studies of glades reported in the literature.

Literature Review

Glades are primary natural communities sensu White and Madany (1978). Primary communities have soil which is thin or absent so that the parent material is at or near the surface. In addition, primary communities are maintained indefinitely at an apparently early stage of succession by the substrate or by natural forces such as erosion or microclimate. Several definitions have been proposed for glades. One group of definitions describes glades as treeless or sparsely wooded openings in forests, with bedrock at or near the surface (Galloway 1919, Baskin et al 1968, White & Madany 1978, Kurz 1981). Other definitions emphasize to a greater or lesser degree the presence of herbaceous vegetation in treeless areas (McVaugh 1943, Skinner et al 1983). Skinner et al (1983) defined a glade as a "cedar-bluestem savanna," although numerous glades have been reported in which neither Andropogon spp. nor Schizachyrium scoparium (See Appendix A for a list of scientific names and synonyms) is present (Baskin & Baskin 1985, Hinterthuer 1977, Quarterman 1950, Jeffries 1987). The near universal presence of eastern red cedar on limestone and dolomite glades has led to the use of the term "cedar glade" interchangeably with the term glade (Baskin & Baskin 1985). This usage seems particularly common in Arkansas. Baskin & Baskin (1989) state that cedar glades are concentrated in the central Tennessee basin and in the Ozark plateau.

Some authors have gone so far as to equate cedar glades with red cedar woodlands or cedar thickets (Harrill et al 1977, Bailey 1976, Babcock 1978). Quarterman (1989) states that cedar forests, per se, are not cedar glades. Quarterman also states that "cedar barren" is often used synonymously with cedar glade, but that barrens share greater similarity to prairies than to glades. Also the use of the term "barrens" is often equated with savanna communities (Nelson 1985).

Since glades are a type of opening in otherwise forested land, it seems incongruous to use the presence of a forest species to define a glade community. Additionally, glades may be found in which cedar is not a major component. More appropriately, glade communities have come to be defined by substrate type (Nelson 1985, Quarterman 1989, Glenn-Lewin and Ver Hoef 1988) and by the presence of certain indicator species (Baskin & Baskin 1975, Nelson 1985).

For the purposes of this study I shall use the simpler definition of glade as an opening with shallow soils or bare rock in an otherwise forested landscape. I choose this definition because it makes fewer assumptions about what species must be found within the opening, while still limiting glades to xeric communities with shallow or no soil. For practical purposes I differentiated glades from bluff communities by the latter having slopes of greater than 50%. (Only one area of savanna was discovered. It was differentiated from the glades by substrate differences,

topographic differences, and by its extensiveness, as well as by structural vegetative differences.)

Descriptions of glade plant communities are found in the literature as early as Safford (1851). This and other reports on glade communities (Gattinger 1901, Galloway 1919, Harper 1926, Freeman 1932) concentrated on the limestone glades of the middle Tennessee basin. Harper (1920) described glade communities in northern Alabama.

Freeman (1932) was the first to measure environmental factors on glades and to relate those to the plants present. Factors which he found to affect seasonal changes in community composition were depth, fertility, and water content of the soil, with soil water relationships being the most important single factor producing variations for plant communities on different aspects of the site. Several authors have noted that different species occupied different parts of glades based upon soil depth (Quarterman 1950, Baskin & Baskin 1973, Cloutier 1987). Kucera and Martin (1957) found that soil was deeper in forests around glades than in glades themselves. In addition, they found greater moisture retention ability and lower pH in the forest soil. However, Jeffries (1987) found no significant differences between glade soils and surrounding forest soils when comparing pH, organic matter, or nutrients.

Quarterman (1950) developed an inferred successional pathway for glades based upon soil depth and assuming soil accumulation over time. She defined three glade

subcommunities: xeric (soil depth 0-5 cm.), subxeric (soil depth 5-20 cm.), and submesic (soil depth greater than 20 cm.). Her description of the importance of jointing (cracks) in limestone substrates as areas of soil accumulation and tree invasion has been verified by other authors (Erickson et al 1942, McVaugh 1943, Nelson 1985).

The type of bedrock, slope, and aspect also contribute importantly to glade formation and glade size. In the southwestern Missouri Ozarks, Kucera and Martin (1957) found forests on limestones with high chert content, while glades were located on siliceous, dolomitic limestone which is resistant to weathering. In the eastern Missouri Ozarks, Erickson et al (1942) found that glades were located on thin-bedded relatively non-cherty dolomites perched atop impermeable massive strata. Baskin and Baskin (1973) differentiated between glades found on thin-bedded limestone and those found on thick-bedded limestone. Thick-bedded "flat rock" glades contained a different species composition than thin-bedded glades. For example, plants associated with Sporobolus vaginiflorus differ on the two glade types (Baskin & Baskin 1973). Additionally, the soil depths at which S. vaginiflorus dominates in thin-bedded Lebanon limestone is different from where it dominates on thick-bedded Pierce and Carter limestones.

Several theories concerning the origin and presence of glade patches have been offered. Harper (1920) theorized that

a lack of earthworms in glade soils resulted in the presence of glade communities. Erickson et al (1942) found that grazing was detrimental to glades, encouraging eastern red cedar encroachment, and concluded that grazing was not a factor in glade origin or maintenance. Some authors consider glades to be relics of a more widespread plains flora, remnants of an eastward prairie migration during the post-Wisconsin glacial xero-thermic (Palmer 1921, Steyermark 1934, 1940, 1959).

Several authors considered glades to be edaphic climaxes (Steyermark 1940, Quarterman 1950, Baskin & Baskin 1973, McVaugh 1943). The extreme set of environmental factors which inhibit invasion by woody species and thus maintain glade communities was noted by many authors (Eickson et al 1942, Freeman 1932, Quarterman 1989, Jeffries 1983). Quarterman (1989) listed depth of soil combined with seasonal distribution of precipitation, high irradiance, and extreme temperatures as major factors in location of glades. McVaugh (1943) stated that the combination of a bedrock free from fissures into which tree roots may establish and high erosional activity results in permanent glade communities. Freeman (1932) listed purity of limestone, slowness of bedrock to disintegrate, and erosion as important factors in limestone glade maintenance. Jeffries (1983) stated that slow soil formation combined with erosion from wind and water result in permanent sandstone glade communities. Other authors (Kucera & Martin 1957) emphasized the importance of fire in maintaining

glades, while Harper (1926) minimizes the importance of fire due to the sparseness of glade vegetation. However, Harper (1926) studied "flat rock vegetation", what Baskin & Baskin (1973) refer to as thick-bedded limestone glades or flat rock glades, while Kucera and Martin (1957) reported on thin-bedded glades, communities which have a large component of fire adapted prairie grasses. Erickson et al (1942), studying both types of glades, also discounted fire as an important factor in glade maintenance.

A complete list of factors influencing distribution and extent of glades includes bedrock type, soil conditions (including depth), drought, fire, and erosion (Steyermark 1940, Kucera & Martin 1957, Guyette & McGinnes 1982, Nelson & Ladd 1983). In particular, the bedrock should possess a high resistance to weathering, limiting the depth to which soil may develop. Kucera and Martin (1957) indicated that non-cherty dolomites were usually more resistant to weathering than were chert bearing limestones. Nelson and Ladd (1983) limited glades to locations with less than 50 cm (20 in) thickness of soil. Soil is kept shallow by active erosion upon moderate or steep slopes as well as by the resistant bedrock. The slight water holding capacity of these shallow soils combined with hot, dry summer climate minimizes or prevents woody invasion upon these sites. Additionally, upon glades dominated by warm season grass species such as Schizachurium scoparium, fire may kill those woody plants which do manage to occupy the glade

(Guyette & McGinnes 1982).

Palmer (1910, 1921) and Steyermark (1940) provided early descriptions of glade communities in the Missouri Ozarks. Early descriptive studies of "cedar glades" in Arkansas (Turner 1935, 1937) were actually descriptions of xeric cedar forest communities. This "cedar forest/cedar glade" approach was continued by Bailey (1976) and Babcock (1976, 1978) in their analyses of the vegetation of the Buffalo National River. Bailey (1976) also cites Hite (1959), Fullerton (1964), and Sullins (1970) as reporting cedar glades which are in fact forest communities.

Other researchers have studied "true glades." Hinterthuer (1977) reported upon two sandstone and two limestone glades in northwest Arkansas. Both sandstone glades were "flat rock" glades sensu Baskin and Baskin (1973). One limestone glade was described as "late succession with a well-established woods and understory." The second limestone site is located inside the Buffalo National River near Ponca. This site is located along a heavily used trail and the presence of several non-native species, in addition to species such as path rush, indicate that the site is a disturbed habitat. Inspection of this site has shown it to be a very steep bluff with a narrow trail traversing it. The species identified by Hinterthuer (1977) as Bothriochloa saccharoides occupies an area with a slope of approximately 60%. By the definition used in this paper this site is a bluff community, not a glade community.

The four sites documented by Hinterthuer (1977) had three species in common: Juniperus virginiana, Penstemon arkansanus, and Erigeron strigosus. Additionally, the limestone sites had only 26 of 129 species in common, while the sandstone sites had only 27 of 59 species in common. This lack of common species means that the four sites studied by Hinterthuer (1977) represent four very different communities.

Jeffries (1983, 1985, 1987) looked at sandstone glades in northwestern Arkansas, although none near the Buffalo River. Unlike Hinterthuer (1977), who found no little bluestem at any of her four locations, he found a high incidence of little bluestem on all sites studied. However, Jeffries found little correspondence between the species on the sites and the species listed as characteristic of sandstone glades by Nelson and Ladd (1983).

Keeland (1978) studied calcareous glades in northwest Arkansas and, using the successional sequence proposed by Quarterman (1950), divided them into four types: grassland-cedar, cedar, cedar-hardwood, and hardwood types. Only the grassland-cedar type and the cedar type glades have a significant prairie/glade species component. Furthermore, only two of the characteristic species listed by Nelson and Ladd (1983) were found on the grassland-cedar glade described by Keeland.

Study Area

The Buffalo National River is located in the Ozark Highlands of northwestern Arkansas between the Boston Mountain, Salem Plateau, and Springfield Plateau subdivisions of the Ozarks (Foti 1974). It is the river's proximity to the escarpment separating these subdivisions which accounts for the area's rugged topography.

The watershed of the Buffalo River is 113 km (70 mi) long and averages 35.4 km (22 mi) wide. Of the 3595 km² (1388 mi²) or 359,600 ha (888,320 ac) drained by the Buffalo River, 383 km² (148 mi²) or 38,500 ha (95,000 ac) are within the park (Anon (draft)). The area was designated a National River in 1972. For purposes of management, the Buffalo National River is divided into three sections: the upper river from the river source to Carver, the middle river between Carver and Maumee, and the lower river below Maumee to its confluence with the White River (See Figure 1).

The river originates in the Boston Mountains and drops almost 610 m (2000 ft) to join the White River near the town of Buffalo City. The river channel has carved a valley through Ordovician sandstones and limestones. The park's elevations range from 117 m (385 ft) to 727 m (2385 ft). The middle district has less elevational variation than either the upper or the lower district. Some bluffs in the lower district reach to 150 m (500 ft) above the river.

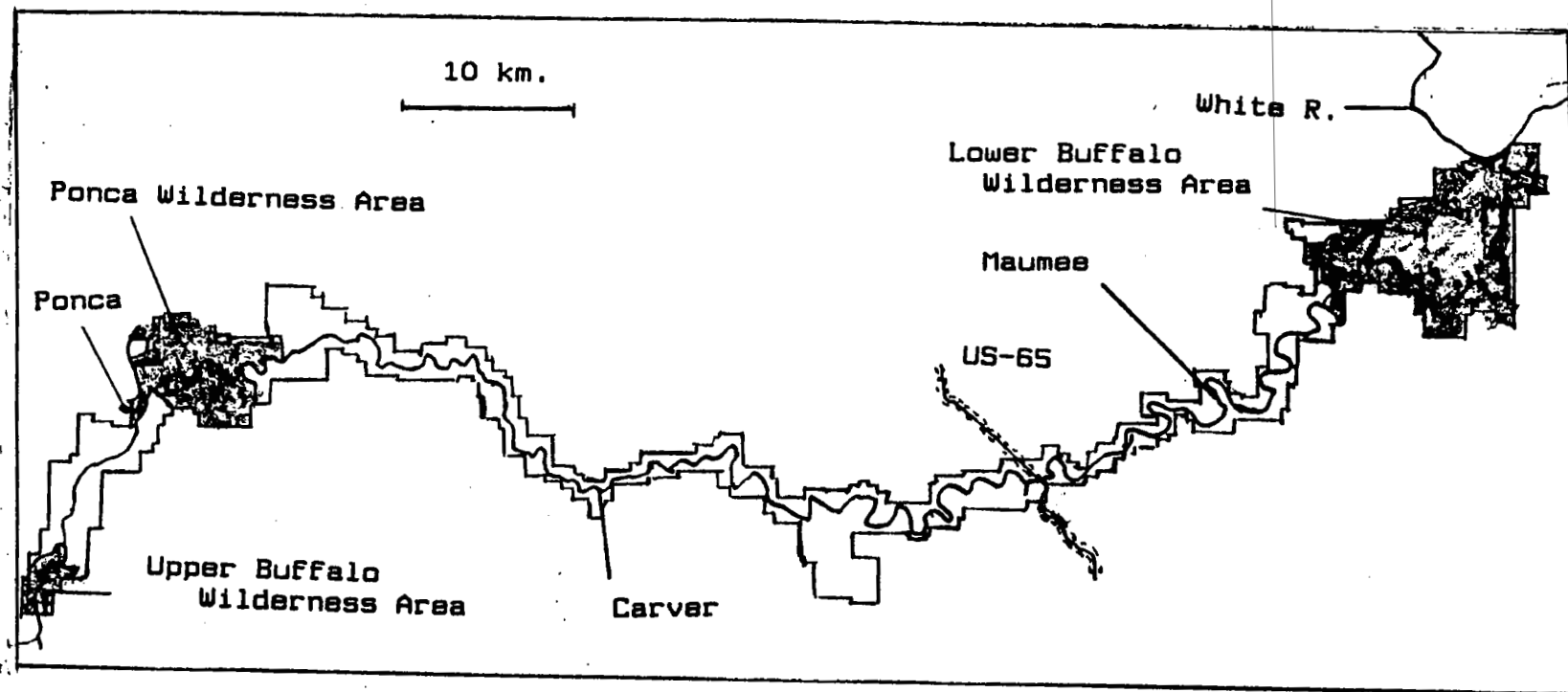


Figure 1. Map of the Buffalo National River, Arkansas

The stratigraphy of the area is presented in Table 1 Ponca is in the upper section and U.S. 65 is in the middle section of the river. No complete data on the stratigraphy of the lower section was available, so data from the Sylamore area east of the Lower Buffalo Wilderness is presented. The stratigraphy used by the NPS for maps at the park is also presented; however, there is some concern that this stratigraphy is incorrect (Mott personal communication).

The sandstone of the upper river district is identified as Newton sandstone (McFarland III 1988). The sandstone of the middle and lower sections of the river is identified as St. Peter sandstone (Craig 1988, Craig & Deliz 1988) although there is some indication that Calico Rock sandstone may also be present in the lower river area (Jeffries 1983, Mott personal communication). However, all 3 sandstones are of the middle Ordovician Everton formation (Jeffries 1983, McFarland III 1988) and are virtually identical both chemically and microscopically (Mott personal communication).

Several limestone strata are found within the Buffalo National River. Plattin, Kimmswick, and Fernvale limestones are all located stratigraphically above the massive St. Peter sandstone and might be expected to harbor good glade sites due to this stratigraphic location and due to their topographic location above the steep bluffs. The Plattin limestone varies from lime mudstone to dolomicrite, a rock in which the original limestone has been partially replaced by dolomitic material.

Table 1. Stratigraphy of the Buffalo River Area

Strata	Age	Location Found:			
		Ponca	U.S.65	Sylamore	NPSa
(un-named)	Pennsylvanian	*b	*		*
Fayetteville shale	Upper Mississippian	*			
Batesville formation	Upper Mississippian	*	*		
Boone formation	Upper Mississippian				*
Boone limestonec	Early Mississippian	*	*	*	
St Joe limestoned	Early Mississippian	*	*	*	
St. Clair limestone	Silurian				*
Cason shale	Upper Ordovician		*	*	*
Fernvale limestone	Upper Ordovician	*	*	*	*
Kimmswick limestone	Middle Ordovician			*	
Plattin limestone	Middle Ordovician	*	*	*	*
Joachim dolomite	Middle Ordovician			*	
St. Peter sandstone	Middle Ordovician		*	*	*
Newton sandstone	Middle Ordovician	*			
Everton formation	Middle Ordovician	*	*		*
Powell dolomite	Early Ordovician	*			*
Cotter dolomite	Early Ordovician				*

aNational Park Service

bListed for this location or by this reference

cMember of the Boone formation

dBasal member of the Boone formation

Stratigraphy for Ponca is from Craig (1988); stratigraphy for U.S. Highway 65 at the Buffalo River bridge is from Craig and Deliz (1988); and stratigraphy for Sylamore is from McFarland III (1988). Strata listed by the National Park Service on their topographic maps for the Buffalo National River is provided for comparison.

Kimmswick and Fernvale limestones are described as finely crystalline, a trait which should make these strata slow to erode and slow to form soil. No mention is made of significant chert inclusions in these three limestones (Craig and Deliz 1988).

Annual precipitation for the Buffalo National River ranges from 112 to 132 cm (44 to 52 in). Mean January temperature is 4 degrees C (39 degrees F); minimum temperatures can be less than -18 degrees C (0 degrees F). Maximum temperatures can exceed 38 degrees C (100 degrees F). Mean first and last frost dates are October 21 and April 13. The growing season is 190 to 200 days (U.S. Department of Commerce 1974).

The dominant vegetation of the area is oak-hickory and oak-pine forest. Before purchase by the National Park Service, the area within the Buffalo National River was a mosaic of woodlands and of small farms, producing primarily pasture and hay crops. The woodlands are regrowth forests which replaced the virgin forests harvested and then burned in the 1800's and early 1900's.

Within the Buffalo National River are three designated Federal wilderness areas: the Upper Buffalo Wilderness Area comprising 890 ha (2200 ac) near the river's headwaters, the Ponca Wilderness Area comprising 4575 ha (11,300 ac) between Ponca and Kyle's Landing, and the Lower Buffalo Wilderness Area comprising 9110 ha (22,500 ac) between Buffalo Point and the mouth of the river near Buffalo City (Anon (draft)).

Methods

To locate glade sites, I used aerial photographs and tract maps showing land use at the time of purchase by the NPS. Areas of search were initially confined to xeric areas within the cedar glade forest type. In addition to the use of aerial photographs, several individuals familiar with the area were interviewed to discern if they knew of glade sites. The presence of glade type vegetation was determined by a field visit. Because of the limited time available each glade was visited only once between June 15th and August 10th, 1991. Location on the map, slope, aspect, and size were recorded for each site. Each vascular plant species on the site was recorded, and an estimate of its abundance was made using a subjective five point scale: Abundant (widespread with high cover, a dominant or near-dominant species), Common, Frequent, Occasional, Rare (only one or two individuals present). (Note that "Rare" is used as strictly a measure of abundance on a site and does not imply anything concerning regional abundances.) Plant nomenclature follows Steyermark (1963) as updated by Yatshievych and Turner (1990).

The field data were summarized in a species by glade matrix which was used for numerical classification of the glades by Two-Way Indicator Species Analysis (TWINSpan, Hill 1979a). The advantage of TWINSpan is that all species information is used to make the classification. The resulting

groups are created based upon numerous criteria rather than upon a small and possibly spurious collection of differences. In addition, the classification results from the original data matrix rather than from a secondary similarity matrix. Finally, both sites and species are classified (Hill 1979a, Glenn-Lewin and Ver Hoef 1988).

Also, Detrended Correspondence Analysis (DCA, Hill and Gauch 1980) was used to order samples by species composition. DCA was performed by using the computer program DECORANA (Hill 1979b). In addition to producing an ordering of sites, DECORANA also produces an ordering by species.

Results

Forty-two sites were determined to be glades, 12 in the upper river district, 3 in the middle district, and 27 in the lower district. Fifteen of the glades were on limestone substrates, 10 were on limestone over sandstone, 17 were on sandstone, and 1 was on an indeterminate upper Mississippian stratum. Of the 17 sandstone glades, 6 were bare sandstone flat rock glades.

One hundred ninety-three species of vascular plants were identified on the glades (Appendix B). Appendix C lists the plant species and relative abundance values for each glade. Of those, 101 species were found on the glades of the upper district, while 165 species were found on the lower district glades. Twenty-one species (20.8%) were found on the upper district glades but not on the lower district glades. Eighty-five species (51.5%) were found on the lower district glades but not on the upper river glades. The upper district and lower district glades had 80 species in common. Of the 18 species of Graminae identified on Buffalo River glades, 8 (44.4%) were found on upper district glades while 16 (88.9%) were found on lower district glades. Of the 47 species of woody plants found on Buffalo River glades, 34 species (72.3%) were found on upper district glades and 39 species (83.0%) were found on lower district glades.

Of the 51 species found on sandstone glades at Devil's

Den State Park, Arkansas, by Jeffries (1987), 36 (70.6%) were also found on the Buffalo River glades. Of the 44 species found on Calico Rock sandstone glades, Calico Rock, Arkansas, by Jeffries (1985), 26 (59.1%) were found on Buffalo River glades. Of the 40 characteristic species listed by Erickson et al (1942) for glades of the eastern Missouri Ozarks, 23 (57.8%) were also found on Buffalo River glades. Of the 365 species listed by Ver Hoef et al (1991) for glades and wooded surroundings of the Current River, 165 (45%) were also found on the glades of the Buffalo River. Of the 47 species listed by Kucera and Martin (1957) for glades along the White River, Missouri, 26 (55%) were also found on the glades of the Buffalo River. Of the 5 dominant and 11 characteristic species for sandstone glades listed by Nelson and Ladd (1983), 5 and 3 species, respectively, were found on the Buffalo River glades. Finally, of the 22 characteristic species for limestone glades listed by Nelson and Ladd (1983), 10 were found on Buffalo River glades.

Numerical Analysis

The first TWINSpan division (Figure 2) separates "prairie-like" glades (group "0") from dry rocky, woodland openings (group "1"). This division is also highly correlated with substrate type, with limestone substrates

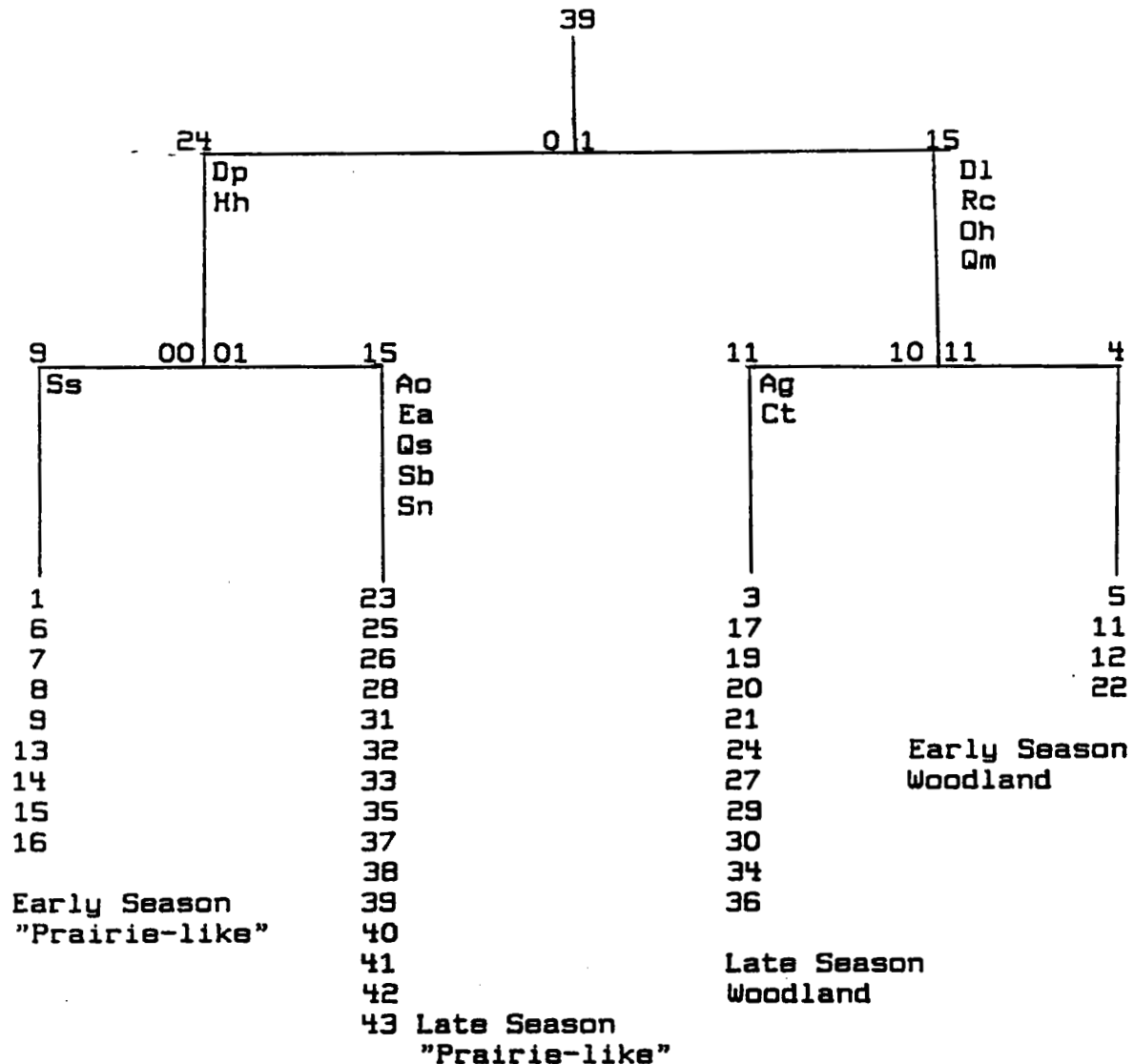
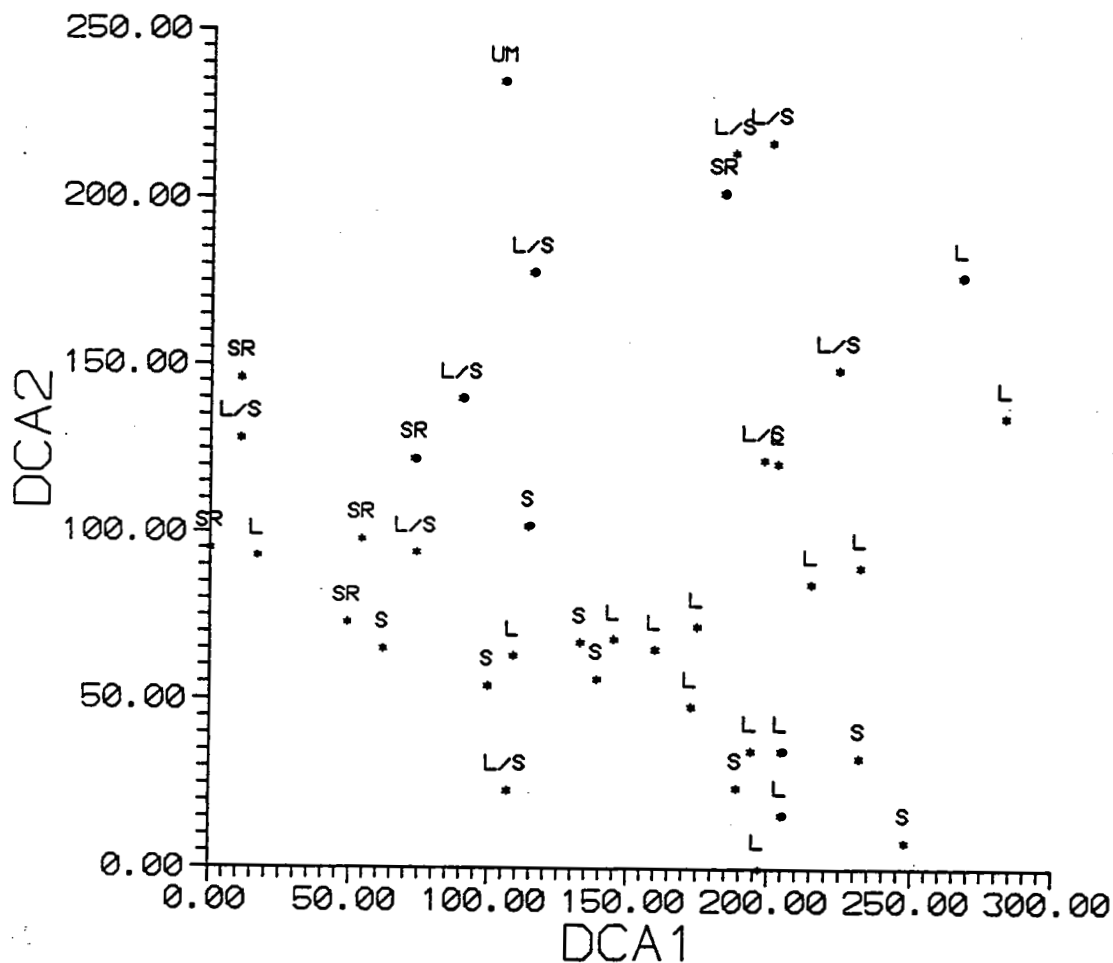


Figure 2. Classification (TWINSpan) of all glade sites from the Buffalo National Riverway. Numbers in the columns at the bottom are the site numbers in each class. Names at the bottom of each column are class names. The number at the top of the vertical lines is the number of sites in each subsequent branch. The binary numbers represent the order of division. Codes for indicator species are: Ag - Acalpha graciliens; Ao - Aster oblongifolius; Ct - Coreopsis tinctoria; D1 - Dicanthelium lanuginosum; Dp - Dalea purpurea; Ea - Eupatorium altissimum; Hh - Helianthus hirsutus; Oh - Opuntia humifusa; Qm - Quercus marilandica; Qs - Quercus stellata; Rc - Rhus copalina; Sb - Smilax bona-nox; Sn - Solidago nemoralis; Ss - Solidago species.

corresponding to the prairie-like glades. The second division of glades by TWINSpan is highly correlated with up-river and down-river sites. However, since upper district glades were visited earlier in the season than lower district sites, the second TWINSpan classification is confounded with seasonal variations.

The first axis of DECORANA may be read as an index of prairie influence, with glades at the extreme right being most prairie-like (Figure 3). DCA axis #1 is also a good indicator of substrate type, with limestone glades on the right. The second DCA axis, like the second TWINSpan division) is a confounding of upriver/downriver sites with early/late season timing of visits to the sites. A graph of DCA axis #1 versus DCA axis #3 (Figure 4) indicates that, for most glades, the two axes are correlated. Nonetheless, axis #3 is not an indicator of prairie influence, but rather an indicator of woody influence. What this axis appears to indicate is that limestone/prairie-like glades are more likely to suffer from invasion by woody species. Glades which appear as outliers on this graph include glades 11 and 22, which are small sites with little diversity, and therefore the few woody species present have more influence on the results of the DECORANA output than would otherwise be the case. Other outliers include glades 14, 15, 16, 28, 42, and 43. All but one of these six glades are sandstone glades which have a high abundance of prairie species (high



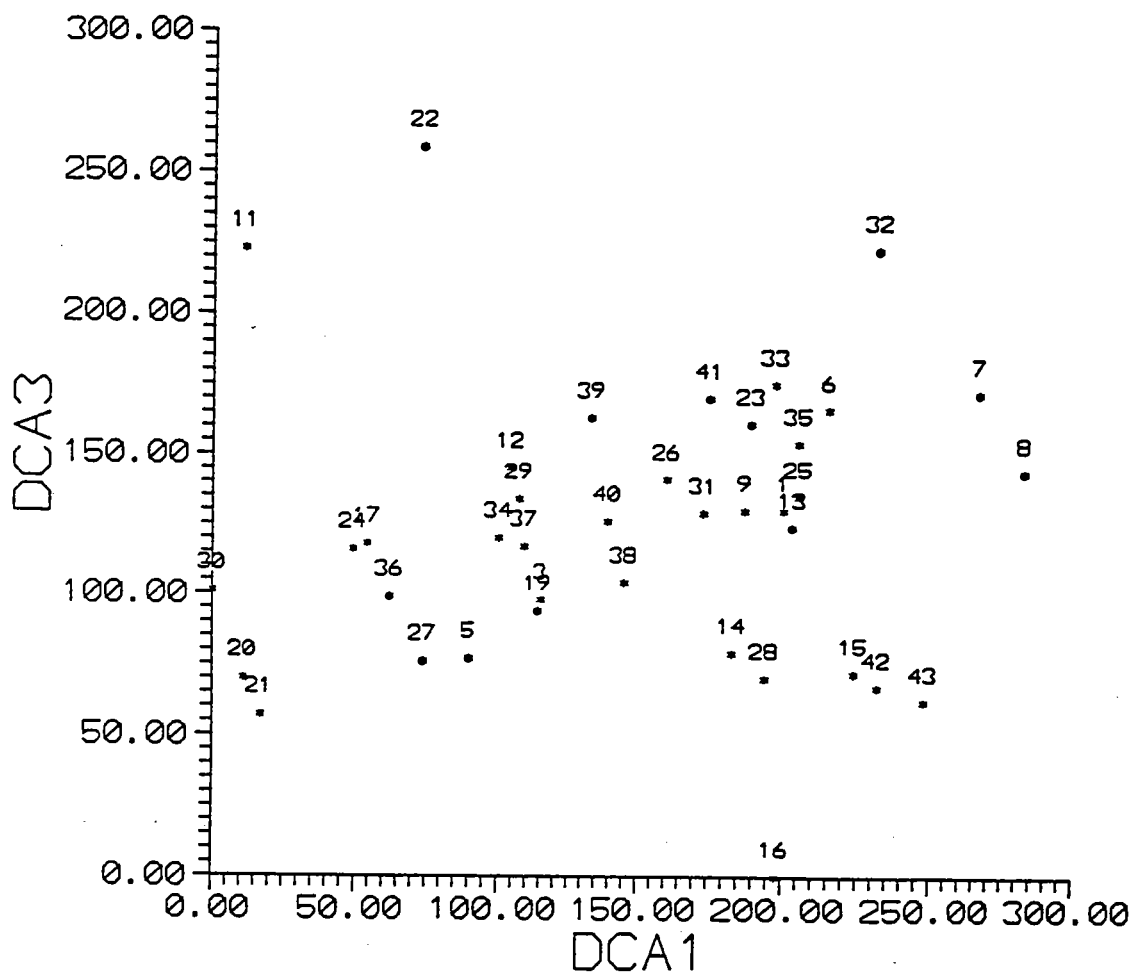


Figure 4. Detrended Correspondence Analysis (DCA) ordination of the glades from the Buffalo National River. DCA 1 and DCA 3 are mathematical constructs representing the first and third greatest amounts of variation in species composition among the glades. Glades are labeled with the identifying numbers which were assigned to the glades.

value on DCA axis #1). The limestone glade, #28, and glades 42 and 43 are positioned atop knolls. What effect this position may have upon glade communities is unknown.

Because of the confounding of upriver and downriver sites with early and late season sampling, I separated the glades into lower district sites and middle and upper district sites, and performed the TWINSpan and DECORANA analyses separately for each group

Upper and Middle Districts

The first TWINSpan classification divides upper and middle river glades by substrate, placing limestone glades 6, 7, 8, 31, 32, and 33 into one group (group "1") and glades 1, 3, 5, 9, 11, and 12, which have other substrates, into the other group (group "0") (Figure 5). Preferential species for the limestone group include Juniperus virginiana and Cercis canadensis. While both groups contain important glade species as preferentials, the presence of Lespedeza cuneata, a non-native species often planted in previous decades as wildlife cover on small farms, on the non-limestone glades indicates human influence upon these sites. The presence of L. cuneata, along with the presence of Panicum lanuginosum, the general lack of diverse communities on these glades, the rectangular shape of some sites, and the presence of old fences on or beside several

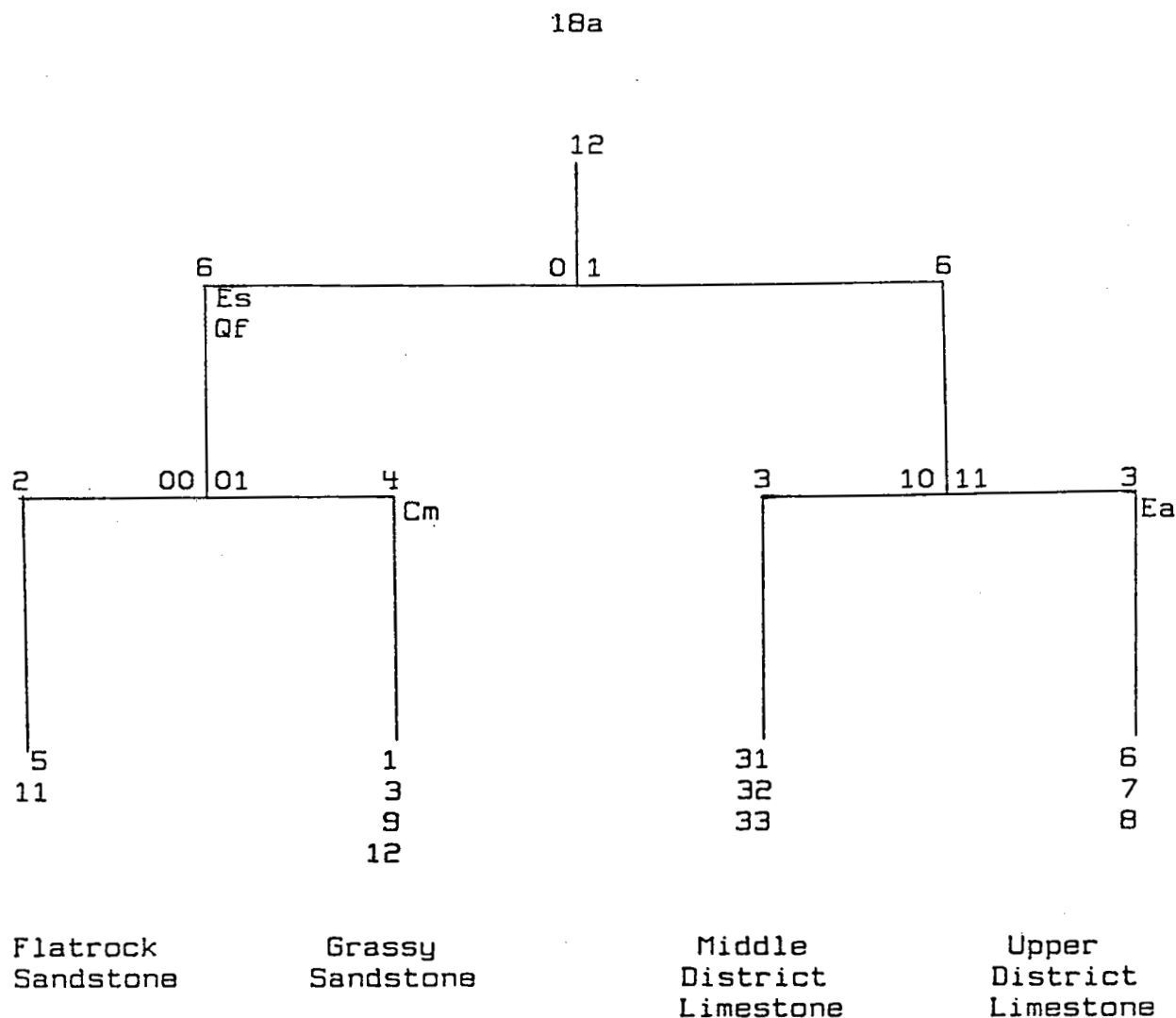


Figure 5. Classification (TWINSpan) of the glade sites from the upper and middle districts of the Buffalo National Riverway. Numbers in the columns at the bottom are the site numbers in each class. Names at the bottom of each column are class names. The number at the top of the vertical lines is the number of sites in each subsequent branch. The binary numbers represent the order of division. Codes for indicator species are: Cm - Croton monanthogynus; Ea - Eupatorium altissimum; Es - Erigeron strigosus; Qs - Quercus falcata.

glades are all indicative of their former use as native pastureland and/or as hayfields.

The second division of the non-limestone glades groups glades 5 and 11 together versus glades 1, 3, 9, and 12. Glades 5 and 11 are both flatrock sandstone glades. Glade 5 has a band of limestone above the sandstone. Preferential species for the group include several small rooted annuals, such as Croton monanthogunus, Hypericum gentianoides, Sedum pulchellum, Talinum calucinum, and the grass Aristida dicotoma, known commonly as poverty grass. Glades 1, 3, 9, and 12 comprise a group of grassy glades dominated by Schizachyrium scoparium. Several prairie/glade species are preferential species on this group of glades. In general, this group has higher species diversity than glades 5 and 11 but is still much less diverse than other glades along the Buffalo River.

TWINSpan divides the limestone glades into 3 upper district glades (6, 7, and 8) and three middle district glades (31, 32, and 33). Preferential species for the middle district glades include many prairie species.

DCA analysis of the upper and middle district glades yields a DCA axis #1 which very clearly ordinales glades by substrate (Figure 6). Glades intermediate on this axis are combination limestone/sandstone sites and sort very well by amount of sandstone influence. Glade #12, the only glade on undifferentiated Upper Mississippian strata is placed to the

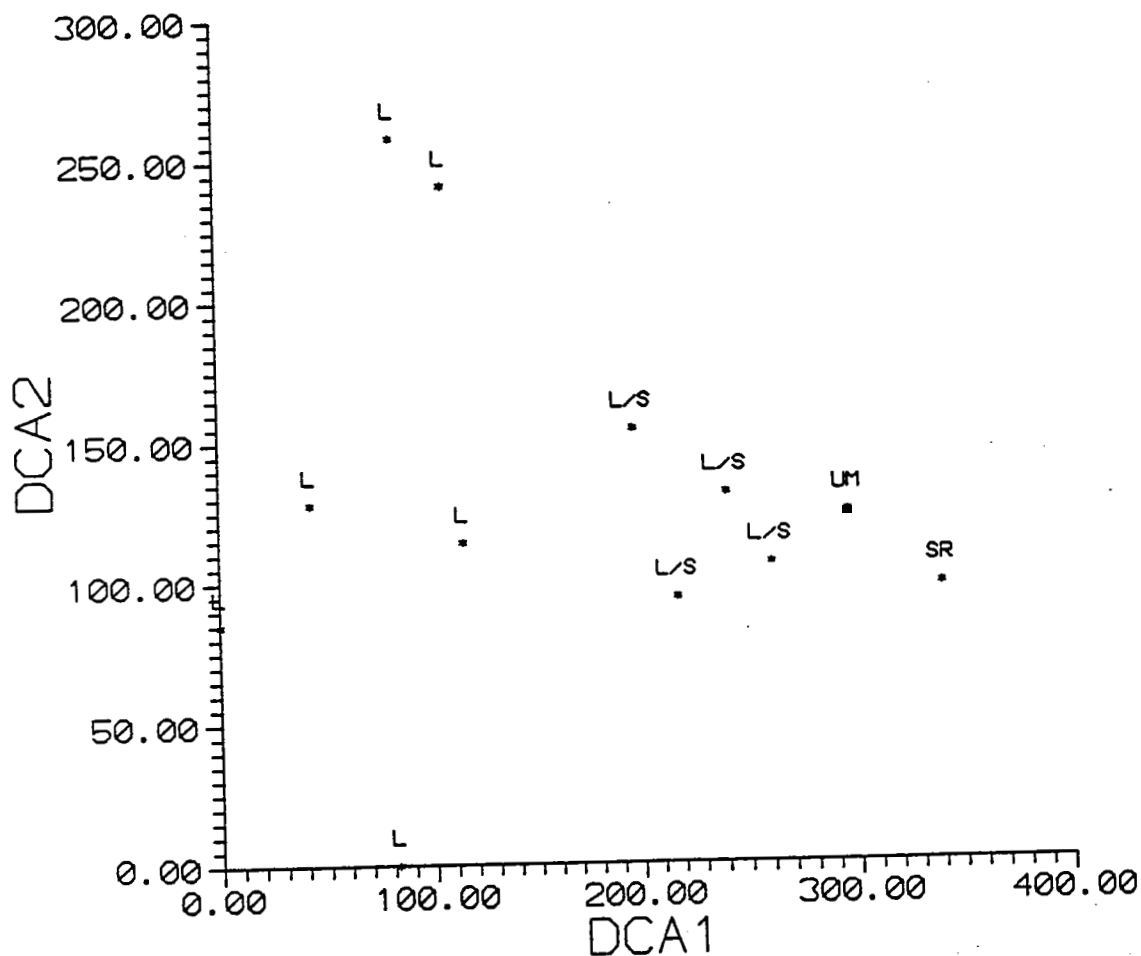


Figure 6. Detrended Correspondence Analysis (DCA) ordination of the glades of the Upper and Middle Districts of the Buffalo National River. DCA 1 and DCA 2 are mathematical constructs representing the first and second greatest amounts of variation in species composition among the glades. Glades are identified by substrate type: L = limestone; L/S = limestone over sandstone; SR = sandstone rock; UM = undifferentiated Upper Mississippian.

extreme right on this axis, a bio-indication that the substrate is actually a Mississippian sandstone.

Most of the variation in DCA axis #2 results from differences in the limestone glades. This axis appears to be a measure of "true prairie" glades versus rocky openings and is positively correlated with grass cover (Table 2).

DCA axis #3 appears to reflect woody invasion. The presence of woody species and understory species typical of woody locations result in a high weighting on this axis.

The variation on DCA axis #4 is the result of differences between glades 5 and 9. Glade 5 is the least diverse of the glades of the middle and upper river districts, with 11 species, while glade 9 is the most diverse of these glades, with 54 species. Other glades are intermediate in diversity. Glade 5's high score on DCA axis #4 indicates that this axis may be a measure of species diversity. Indicative of this interpretation of DCA axis #4 is that, in the species ordination for this axis, only 34 species give values of 100 or greater while species ordinations of DCA axes 1, 2, and 3 all have in excess of 75 species contributing values in excess of 100.

Lower River

TWINSpan's first classification of the lower district glades (Figure 7) divides these sites into "true prairie"

Table 2. Upper and Middle river district glades with values for DCA axis #2 and grass cover values.

Glade #	DCA2	Grass Cover
1	154	3
3	94	3
5	106	2
6	258	4
7	114	2
8	241	4
9	131	3
11	98	1
12	124	4
31	0	1
32	128	3
33	85	2

Grass cover values are: 1 = 0-1%; 2 = 2-5%; 3 = 6-10%; 4 = 11-20%; 5 = 21-100%.

sites (group "0"), with prairie species as preferential species, and into rocky woodland openings (group "1") which have small-rooted annuals as preferential species. The further division of the "true prairie" grouping first separates glades 14, 15, and 16 from all others. These three glades are located in close proximity to one another. All three are sandstone glades, one a flatrock sandstone glade with considerable limestone colluvium upon as much as one-third of its surface.

The second division of the "true prairie" group separates the most grassy glades (25, 28, 42, and 43) from all other "true prairie" glades.

TWINSpan's division of the rocky woodland glades first splits out glade 22, the only glade in the lower district with no S. scoparium or Andropogon gerardii present. Glade 22 is a blufftop flatrock sandstone site. Its location below a long wooded slope indicates that its lack of soil is due almost entirely to erosion. The second division of the rocky woodland glades separates the four glades with the least prairie influence (20, 21, 30, and 34) from the others.

DCA axis 1 corresponds to the degree of "true prairie-ness" of the site (Figure 8). "True prairie" glades appear low on the axis and are primarily limestone glades. High on the first axis are primarily sandstone and flatrock sandstone glades which have a larger component of annuals

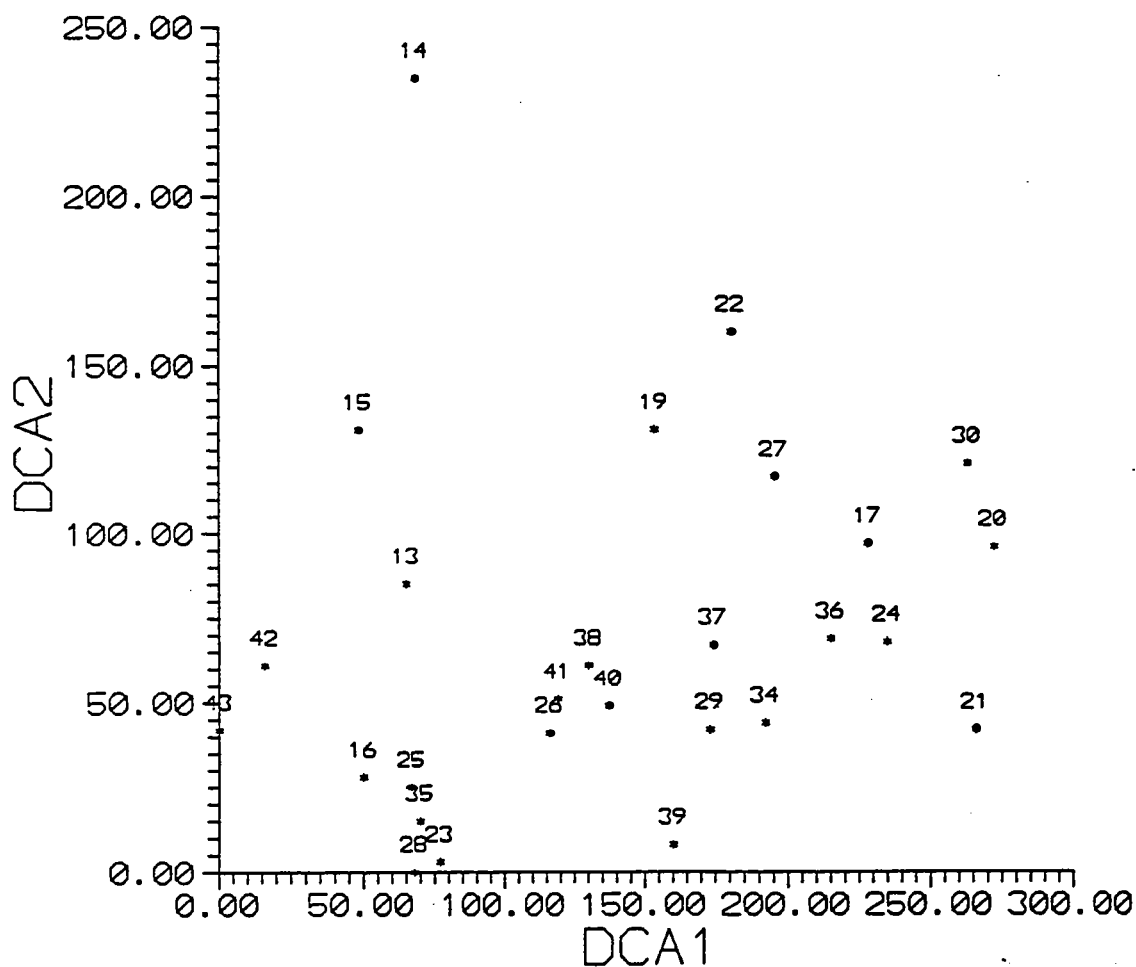


Figure 8. Detrended Correspondence Analysis (DCA) ordination of the glades of the Lower District of the Buffalo National River. DCA 1 and DCA 2 are mathematical constructs representing the first and second greatest amounts of variation in species composition among the glades. Glades are labeled with the identifying numbers which were assigned to the glades.

that occur on thin soil (0 to 7 cm). The two sites lowest on DCA axis #1, while sandstone glades, are outlying portions of a large savanna or barrens area and, for that reason, may not be indicative of other glades of the area. Additionally, glade 14 is a flatrock sandstone glade. However, as mentioned when discussing the TWINSpan analysis, this site is highly influenced by a covering of limestone colluvium on as much as one-third of its surface. This colluvium results in glade 14 having a more limestone-like plant composition, placing it lower on DCA axis #1 than any other flatrock sandstone glade.

DCA axis #2 appears to represent the variation from woody glades (low values) to glades dominated by a combination of prairie species and by small-rooted, xeric annuals (high values).

DCA axis #3 represents the dichotomy between glades dominated by woody species combined with prairie species versus glades dominated by small-rooted, xeric annuals. (Note that this axis differs from axis #2 in placing woody species and prairie species together instead of placing xeric annuals and prairie species together.) Glades which are high on this axis are prairie-like glades but have woody invasion. Figure 9, which plots DCA axis #1 versus DCA axis #3, shows that both axes clearly divide the same groups of glades, those corresponding to TWINSpan's first division. The plot clearly shows two distinct groups of glades: the

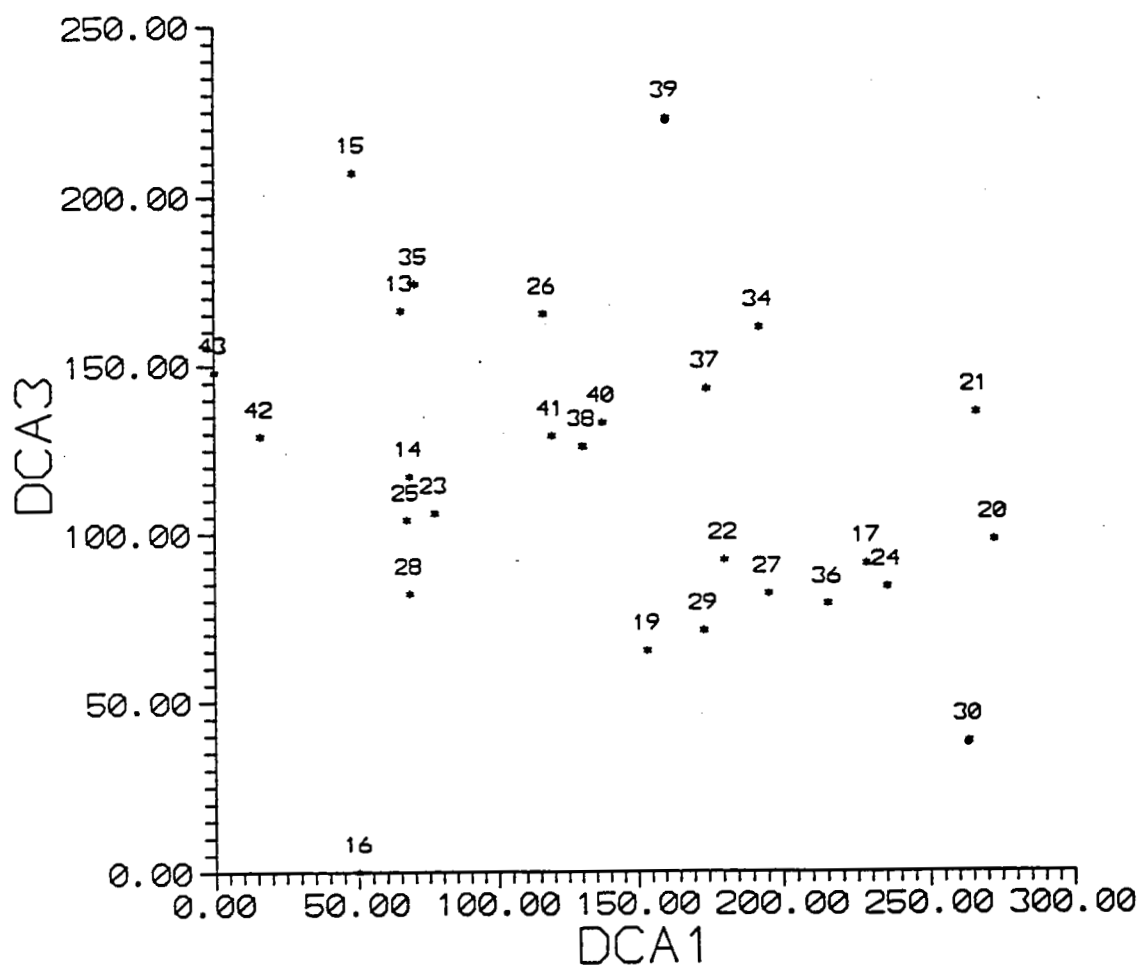


Figure 9. Detrended Correspondence Analysis (DCA) ordination of the glades of the Lower District of the Buffalo National River. DCA 1 and DCA 3 are mathematical constructs representing the first and third greatest amounts of variation in species composition among the glades. Glades are labeled with the identifying numbers which were assigned to the glades.

true prairie glades in the upper left and the dry rocky woodland glades in the lower right.

Substrate type is not clearly represented by any one axis of DCA analysis of the lower district glades, but is part of the ecological basis for DCA axes 1 and 3 (Figure 10). The lack of a definitive axis representing substrate type may result from a confounding of substrate type with other factors including degree of "prairie-ness" and degree of woody invasion, since limestone glades were found to have both more prairie affinity and more woody invasion.

The resulting glade types created by TWINSpan when all sites are included may be defined as Early Season and Late Season "Prairie-like" glades and Early Season and Late Season Woodland glades. When Upper and Middle District glades were considered separately, the glade classifications are Flaarock Sandstone, Grassy Sandstone, Middle District Limestone, and Upper District Limestone. The classifications for Lower District glades are Sandstone "Prairie-like", Grassy "Prairie-like", Other "Prairie-like", No Grass Woodland, Least "Prairie-like" Woodland, and Other Woodland. Glades in the Other "Prairie-like" classification are the "prairie-like" glades with woodland attributes. Likewise, glades classified as Other Woodland are woodland glades with "prairie-like" attributes. This intermediate classification can be easily seen by locating glades in these categories on DCA axis 1 (Figure 8).

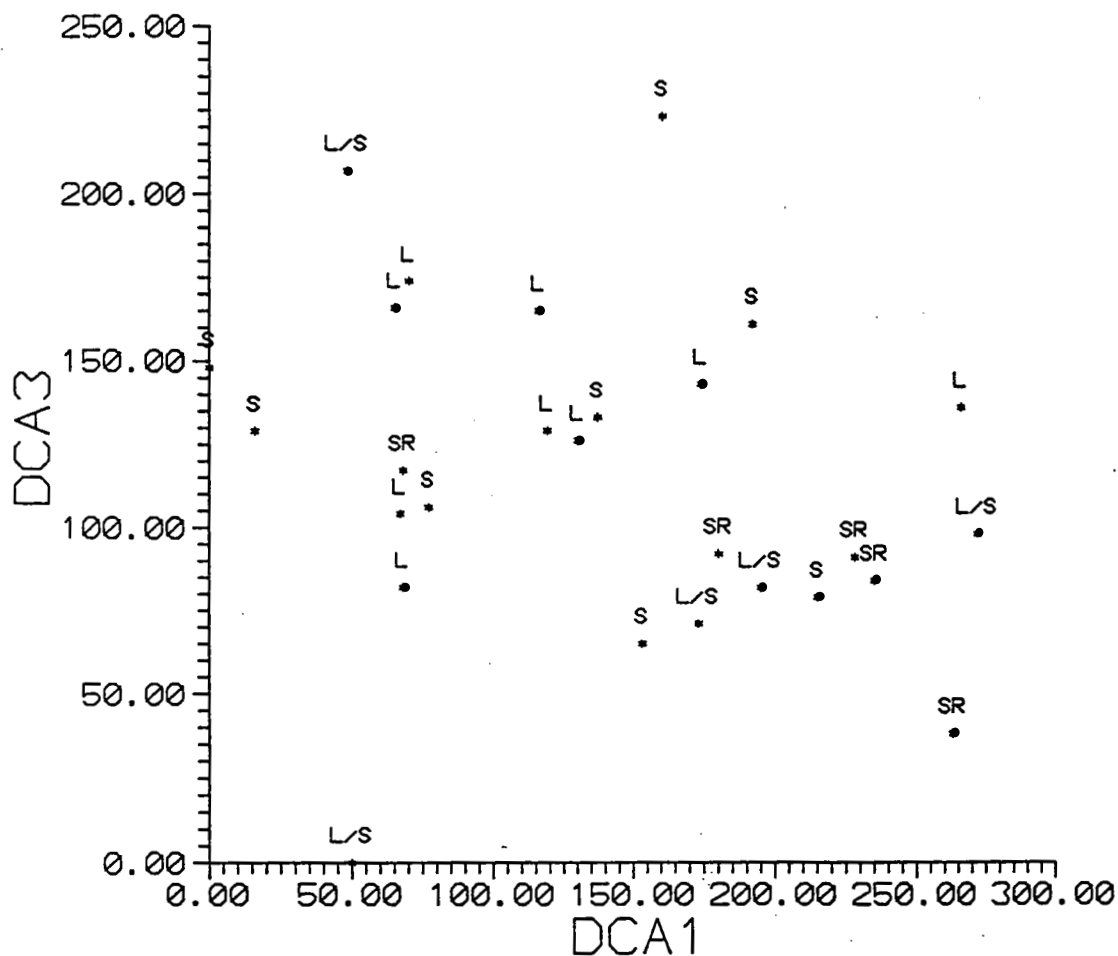


Figure 10. Detrended Correspondence Analysis (DCA) ordination of the glades of the Lower District of the Buffalo National River. DCA 1 and DCA 3 are mathematical constructs representing the first and third greatest amounts of variation in species composition among the glades. Glades are identified by their substrate type: L = limestone; L/S = limestone over sandstone; S = sandstone; SR = sandstone rock.

Discussion

Babcock (1978) has identified nine major forest types in the Buffalo National Riverway. These types, arranged along a gradient of increasing moisture, are cedar glade type, post oak type, pine-oak type, black oak type, white oak type, mixed hardwood type, beech type, elm-oak-maple floodplain type, and willow or gravel-bar type.

Cedar glade vegetation type is defined as: "Red cedar and/or Ashes's juniper occur with post oak, blackjack oak, winged elm, persimmon, winged sumac. Grasses such as little bluestem and species of panic grass may be present." [Emphasis mine] (Babcock 1978) "Cedar glade" is not a glade type but a forest type. It is entirely probable that much of the area represented as cedar glade never was glade.

Field reconnaissance of areas labeled "cedar glade" on vegetation maps revealed several types of communities. Many areas fit the descriptive definition given above very well and, particularly when relic glade species were found, it is easy to conclude that some of these areas were once actual glades. However, several other community types are also labeled as "cedar glade". Young pole stands of white oak (dbh 15-20cm (6-8")) with dead and living cedars mixed with them, hillside oldfields with cedar regrowth, bottomland oldfields with cedar regrowth, and bluffs are also labeled "cedar glade". In each situation where cedar is found in abundance it is as an early

successional invader species. As such, it is a temporary dominant. (Bluff sites are probably the exception.) One might more properly define "cedar glade" vegetation type as an early successional oak-cedar stage of oak-hickory hardwood sere. A label of "oak-cedar" forest type is more suitable than "cedar glade" forest type.

On aerial photographs glades usually appear as areas of sharp contrast with irregular boundaries. These are often bordered by a discernable fringe of eastern red cedar. Perhaps due to the time of year when the photographs were taken or to the small size of most glades, the glades were not that easily seen. In addition, it was difficult to distinguish between glades and areas of sparse vegetation. However, large areas of bare rock did show up on IR color photographs as pale blue areas. These areas proved to be "flat rock" glades.

Interviews with individuals familiar with the area produced mixed results. Unfortunately, the "cedar glade" concept kept interfering with communication on the subject, and I was directed to a variety of xeric oak-cedar forests, oldfields, and bluffs. Finally, after showing a glade site discovered from aerial photographs to an NPS employee, I was directed to a dozen locations where Shizachyrium scoparium was dominant in areas which could be best described as glades.

Locations in the upper and middle river districts were found solely in this manner. In the lower river district, primarily the Lower Buffalo Wilderness, initial glade sites

were also located as described above. However, as glades were found in the lower district and an elevational pattern developed, elevation combined with topographical map features were used to locate all further sites along the lower river.

With the exception of two glades, the sandstone glades of the lower district occur where St. Peter sandstone forms outcroppings upon shoulder slopes. These outcroppings consistently occur at an altitude of 214 m (700 ft). The remaining two sandstone glades of the lower district were located on sandstone which caps the peak of Stair Bluff. This sandstone is found at an elevation of 305 m (1000 ft) and there is some uncertainty as to whether it is St. Peter sandstone or Calico Rock sandstone.

While not all limestone glades of the lower district were found in conjunction with sandstone, most were located upon strata identified as an undifferentiated middle or upper Ordovician limestone (as identified by National Park Service maps) or as Plattin limestone (Craig 1988; McFarland III 1988) and stratigraphically located above and adjacent to the St. Peter sandstone. This positioning of limestone glades above the sandstone strata leaves open the question of the importance of the St. Peter sandstone in creation and maintenance of limestone glades in this area.

Craig and Deliz's (1988) stratigraphy of the Sylamore area identifies the strata located adjacent to St. Peter sandstone as Joachim dolomite rather than as Plattin limestone. If this

strata is a dolomite, its chemical and erosional qualities may differ enough from the limestones of the area to result in numerous glades being located upon this strata. Erickson et al (1942) found numerous small glades on Joachim dolomite in the eastern Missouri Ozarks and mentioned the St. Peter-Joachim escarpment as being important in locating small glades. They also mention the presence of thin-bedded, non-cherty dolomite atop an impermeable massive strata which checks downward percolation of water as important components in glade location. These qualities are possessed by the two strata in question.

Flatrock sandstone glades are found upon St. Peter sandstone in the lower river district and upon Newton sandstone in the upper river district where erosion rates exceed the rates of soil formation and illuvial soil input. These substrates are thick bedded and typically unfractured. Small xeric annuals and perennials grow in depressions where soil collects. The bare rock is mottled with lichens, bryophytes, and reindeer lichen. Woody species, grasses, and herbaceous dicotyledonous species are found primarily along the fringes of the glades where litter and soil collect.

Difficulty arises in categorizing sandstone glades covered by limestone derived colluvium and/or by a thin layer of limestone stratum. Depending upon the depth and evenness of the limestone material, these glades may behave more like limestone sites or like sandstone ones. Glade 14 at Ludlow Bluff is an example of a glade with distinctly heterogeneous

properties. Approximately half of the glade is a flatrock sandstone glade, while the other half, covered with limestone colluvium, is populated by the grasses of a limestone glade. Such a site does not fit well into any category.

Unlike the glades of the White River region of Taney and Ozark counties, Missouri, (Kucera & Martin 1957, Kimmel & Probasco 1980 Guyette & McGinnes 1982) the glades of the Buffalo River are small. Erickson et al (1942), in a study conducted in the northeastern Ozarks near St. Louis, stated that the largest glades were found on lower Powell, Cotter, and Jefferson City dolomites, while smaller glades were found on St. Peter sandstone and Joachim dolomite (a substrate similar in stratigraphic location to the Plattin and Fernvale limestones in the Buffalo National River). Although, Erickson et al (1942) did not find that Gasconade and Eminence formations were important glade bearing strata, Ver Hoef et al (1990) found large glades on both of these strata along the Current River. There is no a priori reason to expect large glades found on Powell, Cotter, Jefferson City, Gasconade, and Eminence stata to be similar to the dynamics of the smaller glades of either the northeastern Ozarks or the Buffalo River area.

A major difference between large and small glades is the relative importance of fire versus erosion in maintenance of the open character of glades. Kucera and Martin (1957) indicate that fire is an important component in maintenance of

open conditions on the large glades of Taney and Ozark counties in southwestern Missouri. Kimmel and Probasco (1980) found that the twenty glades they studied in Taney and Ozark counties had undergone severe invasion by eastern red cedar since 1938. Guyette and McGinnes (1982), studying dendrochronology of eastern red cedar on glades in the same counties, found that fire frequencies had decreased from 3.2 years between fires before settlement to 22 years between fires after settlement. Additionally, on the large dolomitic glades along the Current River, Ver Hoef et al (1990) found that the maximum age of woody species on those glades corresponded to the beginning of fire suppression in the area.

On the other hand, Erickson et al (1942) considered fire to be of little importance in the maintenance of the small glades they studied.

It seems obvious that fire could play little role on the flatrock sandstone glades, as their bare rock surface, lichens, mosses, and pockets of small plants would not sustain a fire. The flatrock glade communities are erosional communities.

The limestone glades and the sandstone glades which are not flatrock glades of the Buffalo National River do produce enough biomass to sustain occasional fires. But the landscape position of many of these glades suggests that fire may not have been important in glade maintenance. Glades located atop bluffs and which have considerable slope are most likely erosional artifacts. Also, it would be difficult to believe

that fire would produce glades which only followed the blufftops.

However, the common practice of using fire as an agricultural tool in the Ozarks up until the 1950's probably means that anthropogenic fire was important on those glades used as native pasture and hayfields. Glades such as glade 9 at Beech Creek, which contain areas of grassy limestone glade and areas of flatrock sandstone glade, likely have mixed histories as to the importance of fire. Other glades, such as glade 37 at Bear Hollow, are undergoing woody invasion at such a rate that much of their area will soon be lost. Such change indicates that some controlling mechanism has recently changed for these sites. Most likely the control of wildfires and/or intentional fires is that change.

Management

Substrate differences and differences in fire histories effect rates of woody invasion. These differences will effect how various glades should be managed in the future. Those glades undergoing invasion by woody species and presumably previously maintained by fire will need active management in order to maintain those areas in an open condition. Where fire is not an option due to safety considerations, the use of chainsaws to cut trees is an appropriate alternative. Additionally, some areas invaded by trees may not produce

enough litter to carry a fire and these areas may also be cleared by cutting trees. Flatrock sandstone glades probably need no management, although monitoring of these locations to identify changes in species compositions and glade sizes is recommended.

Complete management recommendations for all glades located at the Buffalo National River are in Appendix D. In addition to the management considerations mentioned above, consideration has also been given to the proximity of some glades to hiking and riding trails. The proper management of the glades which will be most observed by the public is very important in educating the public as to the value of glade communities. Additionally, when fire is used in glade management, consideration must be given to actively educating the public on the importance of fire as a component of natural communities.

Turkey Mountain Savanna

While searching for glades at the Buffalo National River I also discovered a large and ecologically important savanna. Located within the Lower Buffalo Wilderness Area in sections 33, 34, and 35 T18N R14W, Buffalo City 7.5' USGS Quadrangle, and comprising approximately 400 ha (1000 acres), this savanna is structurally unlike either the forest or the glade communities in that it combines prairie grasses and forbs with large, widely spaced trees. Although evidence of fire scars is

present upon the older trees, recent protection from fire has resulted in invasion by shrubs and small trees. No stumps indicative of cutting are found upon the savanna, although forest sites surrounding the savanna show evidence of cutting. All indications are that the area in question has long exhibited an open character.

This area is unlike any of the glade sites of the Buffalo River region owing to its large size, covering the south sides of two mountains and perhaps much of the north slope of a third, its occurrence on different strata, and owing to the presence of large and undoubtedly older trees as community members. Foti (unpublished) states that this area appears to fit the Nelson (1985) classification of Limestone/Dolomite Savanna.

As this site is the first example of this community type found in Arkansas (Foti unpublished), it is important that this area be preserved through proper management. Additionally, complete mapping of this area, a complete species inventory, a fire history for the site using tree ring analysis, and a survey of aerial photographs and of the surrounding area for other savanna should be undertaken.

In closing, I want to emphasize that, although glades of the Buffalo National River are small and may seem insignificant, their importance and value to the natural environment lie in their very smallness. They, along with

Turkey Mountain Savanna, are the only natural openings in an otherwise forested landscape. Their presence as refuges for plant and animal biodiversity in the area, as well as their value for wildlife in general, make these tiny glades far more valuable than their size alone would indicate. They should be preserved and protected through proper management and enjoyed by future generations as a part of the region's natural beauty.

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Lastly, I would also like to thank Tom Foti, Ecologist for the Arkansas Natural Heritage, for the interest he has shown in the Turkey Mountain Savanna.

Appendix A: Scientific names and synonyms for species
mentioned in text

Schizachyrium scoparium	little bluestem
Juniperus virginiana	eastern red cedar
Sporobolus vaginiflorus	poverty grass
Juncus tenuis	path rush
Bothriochloa saccharoides	silver bluestem
Penstemon arkansanus	Arkansas beard-tongue
Erigeron strigosus	daisy fleabane
Cercis canadensis	eastern redbud
Lespedeza cuneata	sericea lespedeza
Panicum lanuginosum	panic grass
Croton monanthogunus	prairie tea
Hypericum gentianoides	pineweed
Sedum pulchellum	widow's cross
Talinum calycinum	rock pink
Aristida dicotoma	churchmouse three-awn
Andropogon gerardii	big bluestem
Juniperus ashei	Ashe's juniper
Quercus stellata	post oak
Quercus marilandica	blackjack oak
Ulmus alata	winged elm
Diospyros virginiana	persimmon
Rhus copallina	winged sumac
Cladonia sp.	reindeer lichen

Appendix B: List of Species on the glades
of the Buffalo National River

Acalypha gracilens
Acer rubrum
Acer saccharum
Allium canadense
Allium stellatum
Ambrosia artemisiifolia
Amelanchier arborea
Amsonia ciliata
Andropogon gerardii
Antennaria plantaginifolia
Arenaria patula
Aristida dichotoma
Asclepias hirtella
Asclepias verticillata
Asclepias viridiflora
Asplenium platyneuron
Aster linariifolius
Aster novae-angliae
Aster oblongifolius
Aster oolentangiensis
Aster patens
Aster pilosus
Aster species
Astragalus distortus
Baptisia bracteata
Bouteloua curtipendula
Buchnera americana
Bumelia lanuginosa
Calamintha arkansana
Campsis radicans
Carex species
Carya glabra
Carya species
Carya texana
Carya tomentosa
Celtis laevigata
Celtis occidentalis
Celtis tenuifolia
Cercis canadensis
Chamaecrista fasciculata
Chasmanthium latifolium
Chionathes virginicus
Commelina erecta
Convolvulus arvensis
Coreopsis lanceolata
Coreopsis palmata

Coreopsis tinctora
Cornus drummondii
Cornus florida
Crataegus species
Croton capitatus
Croton monanthogynus
Cunila origanoides
Dalea candida
Dalea purpurea
Desmanthus illinoensis
Desmodium species
Dicanthelium clandestinum
Dicanthelium lanuginosum
Dicanthelium linearifolium
Diodia teres
Dioscorea villosa
Diospyros virginiana
Echinacea pallida
Eleocharis compressa
Elymus canadensis
Elymus hystrix
Elymus virginicus
Erigeron strigosus
Eupatorium altissimum
Euphorbia corollata
Fraxinus americana
Galactia regularis
Galium aparine
Galium arkansanum
Gaura longiflora
Glandularia canadensis
Gleditsia triacanthos
Grindelia lanceolata
Hedyotis longifolia
Hedyotis nigricans
Helenium amarum
Helianthus divaricatus
Helianthus hirsutus
Hypericum gentianoides
Hypericum hypercoides
Juglans nigra
Juniperus ashei
Juniperus virginiana
Kummerowia striata
Lechea tenuifolia
Lespedeza capitata
Lespedeza cuneata
Lespedeza repens
Lespedeza virginica
Liatris squarrosa

Liquidambar styraciflua
Lithospermum canescens
Lonicera dioica
Lonicera flava
Manfreda virginica
Marshallia caespitosa
Melilotus alba
Monarda bradburiana
Monarda fistulosa
Muhlenbergia capillaris
Muhlenbergia sobolifera
Nuttallanthus canadensis
Opuntia humifusa
Ostrya virginiana
Oxalis stricta
Palafoxia callosa
Parthenium integrifolium
Parthenocissus quinquefolia
Passiflora lutea
Pedicularis canadensis
Pellaea atropurpurea
Penstemon pallidus
Phoradendron leucarpum
Pinus echinata
Ptelea trifoliata
Pycnanthemum tenuifolium
Quercus alba
Quercus falcata
Quercus marilandica
Quercus prinoides
Quercus rubra
Quercus stellata
Quercus velutina
Rhamnus caroliniana
Rhus aromatica
Rhus copalina
Rhus glabra
Rhynchospora capillacea
Rosa species
Rubus species
Rudbeckia hirta
Rudbeckia missouriensis
Rudbeckia triloba
Ruellia humilis
Sabatia angularis
Salvia azurea
Sanicula odorata
Sassifras albidum
Saxifraga pensylvanica
Schizachyrium scoparium

Schrankia nuttallii
Scutellaria ovata
Sedum pulchellum
Senna marilandica
Silene antirrhina
Silphium laciniatum
Silphium terebinthinaceum
Smilax bona-nox
Smilax glauca
Smilax hispida
Smilax rotundifolia
Solidago nemoralis
Solidago species
Solidago ulmifolia
Sorghastrum nutans
Sporobolus neglectus
Sporobolus vaginiflorus
Strophostyles leiosperma
Stylosanthes biflora
Symphocarpus orbiculatus
Talinum calycinum
Tephrosia virginiana
Toxicodendron radicans
Tradescantia ohiensis
Tragia species
Tridens flavus
Triodanis perfoliata
Ulmus alata
Ulmus rubra
Unknown #19
Unknown #22
Unknown #43
Unknown #45
Unknown #46
Vaccinium arboreum
Vaccinium pallidum
Vaccinium stamineum
Verbesina helianthoides
Vernonia arkansana
Vernonia baldwinii
Viburnum rufidulum
Vitis species
Vulpia species
Yucca glauca
Zizia aptera
Zizia aurea

Appendix C: List of species and relative abundance values by glade

Glade 1. Pruitt Glade

Location: R20W T16N Sec 7. West of Highway 7 bridge at Pruitt, north of the Buffalo River.

Andropogon gerardii	3
Arenaria patula	1
Aster species	1
Calamintha arkansana	2
Carex species	4
Carya species	1
Celtis occidentalis	2
Cercis canadensis	3
Coreopsis lanceolata	2
Dalea purpurea	2
Dicanthelium lanuginosum	1
Erigeron strigosus	1
Hedyotis longifolia	3
Juglans nigra	1
Juniperus virginiana	4
Manfreda virginica	2
Monarda bradburiana	2
Nuttallanthus canadensis	3
Opuntia humifusa	1
Parthenocissus quinquefolia	3
Pellaea atropurpurea	2
Quercus falcata	1
Quercus prinoides	2
Quercus stellata	2
Quercus velutina	2
Rhamnus caroliniana	2
Rhynchospora capitellata	1
Rudbeckia missouriensis	3
Ruellia humilis	3
Schizachyrium scoparium	5
Schrankia nutallii	1
Smilax hispida	3
Solidago species	4
Toxicodendron radicans	2
Ulmus alata	1

Glade 3. Grapevine Ridge #2 Glade

Location: R21W T16N Sec 1. Along road west of Hoskin Creek.

Acalypha gracilens	4
Allium canadense	3
Ambrosia artemisiifolia	3
Aster species	1

Bumelia lanuginosa	1
Calamintha arkansana	1
Carya glabra	2
Celtis laevigata	1
Cercis canadensis	2
Coreopsis lanceolata	3
Cornus florida	1
Croton monanthogynus	1
Dalea purpurea	1
Dicanthelium lanuginosum	2
Diodia teres	1
Diospyros virginiana	1
Erigeron strigosus	2
Euphorbia corollata	1
Grindelia lanceolata	1
Hedyotis longifolia	3
Juniperus virginiana	4
Lespedeza capitata	2
Lespedeza cuneata	1
Liquidambar styraciflua	1
Manfreda virginica	2
Nuttallanthus canadensis	1
Opuntia humifusa	2
Parthenocissus quinquefolia	1
Pellaea atropurpurea	2
Pinus echinata	2
Quercus falcata	2
Quercus prinoides	2
Rhamnus caroliniana	2
Rhus aromatica	1
Rhynchospora capitellata	4
Rudbeckia hirta	1
Ruellia humilis	2
Schizachyrium scoparium	5
Smilax glauca	3
Smilax hispida	1
Solidago species	2
Sporobolus vaginiflorus	4
Talinum calycinum	3
Toxicodendron radicans	2
Ulmus rubra	1
Vaccinium stamineum	1

Glade 5. Ozark Glade
 Location: R21W T16N Sec 12. Along Buffalo River Trail
 between Ozark and Pruitt.

Carya glabra	1
Cercis canadensis	1
Croton monanthogynus	4
Erigeron strigosus	2

Juniperus virginiana	3
Opuntia humifusa	2
Quercus falcata	1
Quercus marilandica	2
Quercus prinoides	2
Rhus copalina	2
Schizachyrium scoparium	5

Glade 6. Steel Creek #1 Glade
 Location: R22W T16N Sec 17. Southeast slope along
 Buffalo River Trail east of Steel Creek.

Acer rubrum	1
Andropogon gerardii	2
Carya glabra	2
Carya texana	2
Cercis canadensis	2
Convolvulus arvensis	1
Desmanthus illinoensis	3
Euphorbia corollata	2
Fraxinus americana	1
Helianthus hirsutus	2
Juniperus virginiana	1
Quercus prinoides	2
Quercus stellata	1
Schizachyrium scoparium	4
Smilax glauca	1
Ulmus alata	2
Ulmus rubra	2
Viburnum rufidulum	1

Glade 7. Steel Creek #2 Glade
 Location: R22W T16N Sec 17. At overlook on Buffalo River
 Trail east of Steel Creek.

Amelanchier arborea	1
Celtis tenuifolia	2
Cercis canadensis	1
Crataegus species	1
Fraxinus americana	3
Helianthus hirsutus	3
Juniperus virginiana	2
Parthenocissus quinquefolia	2
Quercus prinoides	1
Rhus aromatica	2
Schizachyrium scoparium	5
Smilax glauca	1
Solidago species	3
Ulmus rubra	2

Glade 8. Steel Creek #3 Glade
 Location: R22W T16N Sec 17. Northwest bluff above
 Buffalo River east of Steel Creek

Amelanchier arborea	2
Aster species	2
Carya texana	3
Celtis tenuifolia	2
Cercis canadensis	1
Convolvulus arvensis	2
Diospyros virginiana	3
Elymus hystrix	1
Euphorbia corollata	2
Fraxinus americana	1
Hedyotis longifolia	1
Helianthus hirsutus	4
Juglans nigra	1
Juniperus virginiana	1
Monarda bradburiana	1
Quercus prinoides	2
Schizachyrium scoparium	5
Solidago species	5
Ulmus rubra	1
Viburnum rufidulum	1

Glade 9. Beech Creek Glade
 Location: R22W T16N Sec 16. Southwest slope along
 Buffalo River Trail east of Beech Creek.

Antennaria plantaginifolia	2
Asclepias viridiflora	1
Aster patens	1
Bumelia lanuginosa	1
Calamintha arkansana	3
Carex species	4
Carya tomentosa	2
Celtis occidentalis	2
Celtis tenuifolia	3
Cercis canadensis	3
Chamaecrista fasciculata	2
Chasmanthium latifolium	1
Dalea candida	2
Dalea purpurea	2
Desmodium species	3
Dicanthelium lanuginosum	3
Diospyros virginiana	2
Echinacea purpurea	1
Eleocharis compressa	1
Erigeron strigosus	2
Euphorbia corollata	1
Fraxinus americana	1

Galium aparine	2
Galium arkansanum	2
Hedyotis longifolia	2
Helianthus hirsutus	1
Hypericum hypericoides	1
Juniperus virginiana	4
Lespedeza capitata	1
Lonicera dioica	1
Manfreda virginica	2
Monarda fistulosa	3
Nuttallanthus canadensis	3
Opuntia humifusa	1
Ostrya virginiana	2
Parthenocissus quinquefolia	3
Pinus echinata	2
Ptelea trifoliata	1
Quercus prinoides	3
Quercus rubra	1
Quercus stellata	2
Rhus aromatica	2
Rudbeckia hirta	1
Rudbeckia triloba	2
Ruellia humilis	1
Schizachyrium scoparium	5
Schrankia nutallii	2
Smilax glauca	2
Smilax rotundifolia	1
Stylosanthes biflora	2
Toxicodendron radicans	3
Ulmus alata	3
Vernonia baldwinii	1

Glade 11. Adair Cemetery Glade
 Location: R21W T16N Sec 10. East of road and southwest
 of Adair Cemetery along unnamed tributary.

Asclepias viridiflora	1
Carex species	4
Carya tomentosa	2
Crataegus species	1
Cunila origanoides	1
Desmodium species	3
Dicanthelium lanuginosum	2
Diospyros virginiana	3
Erigeron strigosus	2
Fraxinus americana	2
Juniperus virginiana	4
Lespedeza capitata	2
Lespedeza cuneata	3
Pycnanthemum tenuifolium	2
Quercus falcata	2

<i>Quercus marilandica</i>	2
<i>Quercus stellata</i>	3
<i>Quercus velutina</i>	2
<i>Rhus copalina</i>	2
<i>Schizachyrium scoparium</i>	5
<i>Schrankia nutallii</i>	1
<i>Smilax glauca</i>	3
<i>Vaccinium stamineum</i>	1
<i>Vernonia baldwinii</i>	2

Glade 12. Chestnut Cabin Glade

Location: R21W T17N Sec 29. North of road and east of Chestnut Cabin at 459 m (1505 ft) elevation on Newberry Point of Gaither Mountain.

<i>Andropogon gerardii</i>	3
<i>Antennaria plantaginifolia</i>	3
<i>Asclepias hirtella</i>	1
<i>Asclepias viridiflora</i>	1
<i>Bumelia lanuginosa</i>	1
<i>Carya tomentosa</i>	2
<i>Croton monanthogynus</i>	1
<i>Dalea purpurea</i>	2
<i>Desmanthus illinoensis</i>	2
<i>Echinacea pallida</i>	2
<i>Euphorbia corollata</i>	1
<i>Fraxinus americana</i>	2
<i>Hedyotis longifolia</i>	3
<i>Heleanthus divaricatus</i>	2
<i>Helianthus hirsutus</i>	2
<i>Lespedeza capitata</i>	1
<i>Liatris squarrosa</i>	2
<i>Lonicera dioica</i>	1
<i>Manfreda virginica</i>	1
<i>Oxalis stricta</i>	1
<i>Pinus echinata</i>	1
<i>Quercus marilandica</i>	2
<i>Quercus prinoides</i>	2
<i>Quercus stellata</i>	2
<i>Rhus glabra</i>	1
<i>Ruellia humilis</i>	1
<i>Schizachyrium scoparium</i>	4
<i>Schrankia nutallii</i>	2
<i>Scutellaria ovata</i>	2
<i>Silphium laciniatum</i>	3
<i>Solidago species</i>	3
<i>Toxicodendron radicans</i>	1
<i>Tragia species</i>	2
<i>Ulmus alata</i>	3

Glade 13. Ludlow Bluff #1 Glade
 Location: R15W T17N Sec 24. Atop southwest facing
 portion of Ludlow Bluff.

Aristida dichotoma	3
Asplenium platyneuron	3
Croton monanthogynus	4
Dicanthelium lanuginosum	2
Diospyros virginiana	2
Festuca species	3
Hypericum gentianoides	4
Juniperus virginiana	4
Opuntia humifusa	3
Quercus falcata	1
Quercus stellata	3
Schizachyrium scoparium	3
Sedum pulchellum	3
Smilax glauca	3
Talinum calycinum	3
Toxicodendron radicans	2
Ulmus alata	3

Glade 14. Ludlow Bluff #2 Glade
 Location: R15W T17N Sec 23. Atop downstream end of
 Ludlow Bluff.

Allium canadense	2
Ambrosia artemisiifolia	1
Amsonia ciliata	4
Andropogon gerardii	2
Asclepias viridiflora	2
Calamintha arkansana	3
Carex species	4
Coreopsis lanceolata	3
Croton monanthogynus	2
Dalea purpurea	2
Desmanthus illinoensis	3
Elymus virginicus	1
Erigeron strigosus	1
Fraxinus americana	2
Gleditsia triacanthos	1
Hedyotis longifolia	3
Helianthus divaricatus	2
Juniperus virginiana	4
Manfreda virginica	2
Quercus stellata	1
Rhamnus caroliniana	2
Rhus aromatica	1
Rhynchospora capillacea	3
Ruellia humilis	3
Schizachyrium scoparium	5

<i>Sedum pulchellum</i>	1
<i>Smilax glauca</i>	1
<i>Solidago species</i>	2
<i>Ulmus alata</i>	2

Glade 15. Ingram Hollow Glade
 Location: R15W T17N Sec 25. On private land
 approximately 0.8 km (0.5 mi) north northeast of
 Devil's Tea Table Rock.

<i>Asclepias viridiflora</i>	1
<i>Bouteloua curtipendula</i>	2
<i>Celtis tenuifolia</i>	2
<i>Coreopsis lanceolata</i>	4
<i>Dalea purpurea</i>	3
<i>Desmodium species</i>	1
<i>Diospyros virginiana</i>	2
<i>Echinacea pallida</i>	3
<i>Euphorbia corollata</i>	2
<i>Hedyotis longifolia</i>	1
<i>Helianthus divaricatus</i>	2
<i>Helianthus hirsutus</i>	3
<i>Juniperus virginiana</i>	3
<i>Manfreda virginica</i>	1
<i>Opuntia humifusa</i>	1
<i>Quercus prinoides</i>	3
<i>Rhus aromatica</i>	2
<i>Ruellia humilis</i>	2
<i>Schizachyrium scoparium</i>	5
<i>Silphium laciniatum</i>	1
<i>Solidago species</i>	2
Unknown 19	3

Glade 16. Tea Table Bluff
 Location: R15W T17N Sec 26. Atop saddle ridge
 north of Devil's Tea Table Rock.

<i>Aster species</i>	2
<i>Bumelia lanuginosa</i>	2
<i>Calamintha arkansana</i>	3
<i>Celtis laevigata</i>	1
<i>Chionanthus virginicus</i>	3
<i>Coreopsis tinctora</i>	3
<i>Croton monanthogynus</i>	3
<i>Dalea purpurea</i>	3
<i>Echinacea pallida</i>	2
<i>Erigeron strigosus</i>	2
<i>Euphorbia corollata</i>	2
<i>Helianthus divaricatus</i>	2
<i>Juniperus ashei</i>	3
<i>Juniperus virginiana</i>	3

Manfreda virginica	1
Opuntia humifusa	1
Partenocissus quinquefolia	2
Pedicularis canadensis	2
Quercus prinoides	4
Rhus aromatica	2
Rosa species	3
Ruellia humilis	2
Sabatia angularis	1
Schizachyrium scoparium	5
Tragia species	3
Ulmus alata	1
Unknown 22	1

Glade 17. Peter Hollow Glade
 Location: R15W T17N. Sec 33. West and south of
 Highway 14, north of Peter Hollow.

Acalypha gracilens	4
Acer rubrum	1
Ambrosia artemisiifolia	2
Carya glabra	2
Chamaecrista fasciculata	1
Coreopsis tinctora	5
Croton capitatus	1
Croton monanthogynus	1
Desmanthus illinoensis	3
Dicanthelium clandestinum	1
Dicanthelium lanuginosum	3
Dicanthelium linearifolium	1
Diodia teres	4
Diospyros virginiana	1
Euphorbia corollata	2
Hedyotis nigricans	1
Hypericum gentianoides	3
Juniperus virginiana	4
Manfreda virginica	2
Opuntia humifusa	3
Pellaea atropurpurea	4
Penstemon pallidus	2
Pinus echinata	3
Quercus falcata	1
Quercus marilandica	3
Quercus rubra	1
Quercus velutina	2
Rhus copalina	2
Rudbeckia missouriensis	5
Ruellia humilis	3
Schizachyrium scoparium	5
Smilax glauca	2
Solidago nemoralis	2

<i>Talinum calycinum</i>	2
<i>Triodanis perfoliata</i>	1
<i>Ulmus alata</i>	2
<i>Vaccinium arboreum</i>	4
<i>Verbesina helianthoides</i>	1

Glade 19. Warner Bluff #1 Glade
Location: R14W T17N Sec 20. On middle knob of Warner Bluff.

<i>Acalypha gracilens</i>	4
<i>Ambrosia artemisiifolia</i>	3
<i>Aster linariifolius</i>	3
<i>Buchnera americana</i>	4
<i>Bumelia lanuginosa</i>	2
<i>Calamintha arkansana</i>	3
<i>Carya glabra</i>	1
<i>Celtis tenuifolia</i>	2
<i>Commelina erecta</i>	1
<i>Coreopsis tinctora</i>	3
<i>Croton monanthogynus</i>	2
<i>Dalea purpurea</i>	3
<i>Desmodium species</i>	2
<i>Dicanthelium lanuginosum</i>	3
<i>Diodia teres</i>	3
<i>Diospyros virginiana</i>	2
<i>Echinacea pallida</i>	2
<i>Fraxinus americana</i>	2
<i>Hedyotis longifolia</i>	3
<i>Hypericum gentianoides</i>	3
<i>Juniperus virginiana</i>	4
<i>Liatris squarrosa</i>	3
<i>Lonicera dioica</i>	1
<i>Manfreda virginica</i>	3
<i>Opuntia humifusa</i>	3
<i>Quercus marilandica</i>	3
<i>Quercus prinoides</i>	4
<i>Rhus aromatica</i>	3
<i>Rhus copalina</i>	3
<i>Rhus glabra</i>	2
<i>Ruellia humilis</i>	3
<i>Schizachyrium scoparium</i>	5
<i>Solidago species</i>	3
<i>Tragia species</i>	2
<i>Vaccinium arboreum</i>	4
<i>Viburnum rufidulum</i>	1

Glade 20. Warner Bluff #2 Glade
Location: R14W T17N Sec 20. On middle knob of Warner Bluff.

<i>Baptisia bracteata</i>	2
<i>Bumelia lanuginosa</i>	3
<i>Chasmanthium latifolium</i>	2
<i>Coreopsis tinctora</i>	4
<i>Croton monanthogynus</i>	3
<i>Dicanthelium lanuginosum</i>	4
<i>Juniperus virginiana</i>	4
<i>Lechea tenuifolia</i>	2
<i>Lespedeza capitata</i>	3
<i>Opuntia humifusa</i>	3
<i>Pinus echinata</i>	3
<i>Quercus falcata</i>	2
<i>Quercus marilandica</i>	3
<i>Quercus stellata</i>	3
<i>Rhus copalina</i>	3
<i>Rhynchospora capillacea</i>	4
<i>Ruellia humilis</i>	2
<i>Schizachyrium scoparium</i>	5
<i>Schrankia nuttallii</i>	2
<i>Sedum pulchellum</i>	3
<i>Stylosanthes biflora</i>	2
<i>Tephrosia virginiana</i>	3
<i>Tradescantia ohimensis</i>	2
<i>Yucca glauca</i>	2

Glade 21. Warner Bluff #3 Glade
 Location: R14W T17N Sec 20. On middle knob of
 Warner Bluff.

<i>Bumelia lanuginosa</i>	3
<i>Coreopsis tinctora</i>	4
<i>Croton monanthogynus</i>	3
<i>Dalea purpurea</i>	2
<i>Dicanthelium lanuginosum</i>	3
<i>Elymus canadensis</i>	3
<i>Lespedeza capitata</i>	3
<i>Opuntia humifusa</i>	2
<i>Pinus echinata</i>	2
<i>Quercus falcata</i>	2
<i>Quercus marilandica</i>	3
<i>Quercus stellata</i>	3
<i>Rhus copalina</i>	4
<i>Ruellia humilis</i>	2
<i>Schizachyrium scoparium</i>	5
<i>Tephrosia virginiana</i>	3
<i>Tradescantia ohimensis</i>	2
<i>Triodanis perfoliata</i>	3
<i>Ulmus alata</i>	2
<i>Vaccinium stamineum</i>	2

Glade 2022 Silver Hollow Glade
 Location: R15W T17N Sec 13. South of Silver
 Hollow.

Aster novae-angliae	1
Coreopsis palmata	4
Dicanthelium lanuginosum	3
Diospyros virginiana	3
Erigeron strigosus	1
Festuca species	3
Fraxinus americana	3
Juniperus virginiana	3
Opuntia humifusa	2
Quercus stellata	1
Rhamnus caroliniana	1
Rhus aromatica	3
Rhus copalina	2
Sedum pulchellum	3
Symphocarpus orbiculatus	2
Ulmus alata	3
Verbesina helianthoides	3

Glade 23 Toney Bend Glade
 Location: R15W T17N Sec 24. At upstream end of
 Ludlow Bluff.

Acer saccharum	1
Andropogon gerardii	4
Antennaria plantaginifolia	4
Asplenium platyneuron	2
Aster oblongifolius	2
Aster patens	2
Bouteloua curtipendula	3
Bumelia lanuginosa	1
Carya texana	3
Celtis occidentalis	1
Chamaecrista fasciculata	3
Coreopsis palmata	1
Dalea candida	1
Dalea purpurea	3
Desmanthus illinoensis	2
Diodia teres	2
Diospyros virginiana	2
Echinacea pallida	3
Elymus canadensis	1
Euphorbia corollata	2
Fraxinus americana	2
Grindelia lanceolata	3
Hedyotis longifolia	2
Helianthus hirsutus	4
Juniperus virginiana	4

<i>Lespedeza capitata</i>	1
<i>Lespedeza virginica</i>	3
<i>Liatris squarrosa</i>	2
<i>Lithospermum canescens</i>	1
<i>Manfreda virginica</i>	1
<i>Marshallia caespitosa</i>	3
<i>Quercus alba</i>	3
<i>Quercus prinoides</i>	4
<i>Quercus velutina</i>	4
<i>Rhus aromatica</i>	1
<i>Rudbeckia missouriensis</i>	3
<i>Ruellia humilis</i>	3
<i>Salvia azurea</i>	2
<i>Saxifraga pensylvanica</i>	2
<i>Schizachyrium scoparium</i>	5
<i>Smilax bona-nox</i>	2
<i>Solidago nemoralis</i>	1
<i>Sorghastrum nutans</i>	2
<i>Symphocarpus orbiculatus</i>	3
<i>Ulmus alata</i>	4
<i>Zizia aurea</i>	1

Glade 24 Fishtrap Hollow East Glade
 Location: R14W T17N Sec 29. On private land east
 of the eastmost branch of Fishtrap Hollow.

<i>Acalypha gracilens</i>	5
<i>Andropogon gerardii</i>	3
<i>Arenaria patula</i>	1
<i>Aster oolentangiensis</i>	1
<i>Bouteloua curtipendula</i>	2
<i>Buchnera americana</i>	1
<i>Chamaecrista fasciculata</i>	2
<i>Coreopsis tinctora</i>	4
<i>Croton capitatus</i>	2
<i>Dicanthelium lanuginosum</i>	5
<i>Diodia teres</i>	3
<i>Dioscorea villosa</i>	1
<i>Diosypros virginiana</i>	2
<i>Elymus canadensis</i>	2
<i>Fraxinus americana</i>	1
<i>Grindelia lanceolata</i>	2
<i>Hypericum gentianoides</i>	4
<i>Juniperus virginiana</i>	3
<i>Lespedeza capitata</i>	1
<i>Opuntia humifusa</i>	1
<i>Parthenocissus quinquefolia</i>	2
<i>Pinus echinata</i>	2
<i>Quercus marilandica</i>	4
<i>Rhus aromatica</i>	1
<i>Rhus copalina</i>	3

<i>Rudbeckia missouriensis</i>	4
<i>Schizachyrium scoparium</i>	5
<i>Silphium laciniatum</i>	1
<i>Smilax bona-nox</i>	1
<i>Sporobolus vaginiflorus</i>	5
<i>Talinum calycinum</i>	4
<i>Vaccinium arboreum</i>	3

Glade 25 Warner Bluff #4 Glade
 Location: R14W T17N Sec 20. East of Fishtrap
 Hollow at downstream end of Horseshoe Bend.

<i>Ambrosia artemisiifolia</i>	1
<i>Andropogon gerardii</i>	3
<i>Arenaria patula</i>	1
<i>Aster oblongifolius</i>	2
<i>Aster patens</i>	1
<i>Bumelia lanuginosa</i>	1
<i>Calamintha arkansana</i>	3
<i>Carya texana</i>	1
<i>Celtis tenuifolia</i>	1
<i>Croton monanthogynus</i>	2
<i>Dalea purpurea</i>	1
<i>Desmanthus illinoensis</i>	3
<i>Diospyros virginiana</i>	1
<i>Echinacea pallida</i>	2
<i>Eupatorium altissimum</i>	3
<i>Euphorbia corollata</i>	1
<i>Fraxinus americana</i>	2
<i>Glandularia canadensis</i>	2
<i>Hedyotis nigricans</i>	4
<i>Helianthus hirsutus</i>	2
<i>Lespedeza capitata</i>	2
<i>Manfreda virginica</i>	1
<i>Opuntia humifusa</i>	2
<i>Rhus aromatica</i>	2
<i>Rhus glabra</i>	1
<i>Rosa species</i>	1
<i>Ruellia humilis</i>	1
<i>Saxifraga pensylvanica</i>	1
<i>Schizachyrium scoparium</i>	5
<i>Schrankia nuttallii</i>	1
<i>Smilax bona-nox</i>	2
<i>Solidago nemoralis</i>	2
<i>Sorghastrum nutans</i>	1
<i>Sporobolus vaginiflorus</i>	2
<i>Symphocarpus orbiculatus</i>	3
<i>Tridens flavus</i>	1
<i>Ulmus alata</i>	3

Glade 26 Granite Mountain Glade
 Location: R14W T18N Sec 34. West slope on north
 side of Granite Mountain.

Andropogon gerardii	4
Aster patens	1
Bouteloua curtipendula	4
Carya texana	2
Chamaecrista fasciculata	1
Coreopsis lanceolata	3
Coreopsis palmata	3
Croton monanthogynus	2
Dalea candida	2
Dalea purpurea	2
Dicanthelium lanuginosum	2
Diospyros virginiana	3
Echinacea pallida	3
Eupatorium altissimum	4
Grindelia lanceolata	2
Hedyotis nigricans	1
Helianthus hirsutus	3
Juniperus virginiana	2
Lespedeza capitata	3
Lespedeza virginica	1
Liatris squarrosa	2
Pellaea atropurpurea	2
Quercus marilandica	4
Quercus prinoides	1
Quercus stellata	3
Rhus aromatica	1
Rudbeckia missouriensis	4
Ruellia humilis	4
Saxifraga pensylvanica	1
Schizachyrium scoparium	5
Schrankia nuttallii	3
Senna marilandica	1
Silphium laciniatum	3
Smilax bona-nox	4
Solidago nemoralis	2
Sporobolus neglectus	2
Sporobolus vaginiflorus	3
Tephrosia virginiana	2
Toxicodendron radicans	2
Ulmus alata	2

Glade 27 Cow Creek #1 Glade
 Location: R14W T17N Sec 9. East of the hiking
 trail on the first ridge south of Cow Creek.

Acalypha gracilens	5
Ambrosia artemisiifolia	3

Andropogon gerardii	5
Aster patens	1
Bumelia lanuginosa	2
Carya texana	1
Celtis tenuifolia	1
Chamaecrista fasciculata	2
Commelina erecta	1
Coreopsis lanceolata	3
Croton capitatus	1
Desmanthus illinoensis	4
Desmodium species	1
Dicanthelium lanuginosum	4
Dicanthelium linearifolium	2
Diodia teres	4
Euphorbia corollata	2
Gleditsia triacanthos	1
Helianthus hirsutus	2
Hypericum gentianoides	2
Juniperus virginiana	4
Lespedeza capitata	3
Lespedeza repens	1
Lespedeza virginica	2
Manfreda virginica	1
Opuntia humifusa	2
Penstemon pallidus	1
Quercus marilandica	5
Quercus stellata	2
Rhynchospora capillacea	3
Rudbeckia hirta	2
Ruellia humilis	3
Saxifraga pensylvanica	1
Schizachyrium scoparium	5
Sedum pulchellum	3
Silene antirrhina	3
Stylosanthes biflora	1
Ulmus alata	1

Glade 28

Cow Creek #2

Location: R14W T17N Sec 10. South of hiking trail
which descends to Cow Creek.

Andropogon gerardii	5
Bouteloua curtipendula	3
Bumelia lanuginosa	1
Calamintha arkansana	2
Celtis tenuifolia	1
Croton monanthogynus	2
Dalea purpurea	2
Eupatorium altissimum	4
Hedyotis nigricans	2
Helianthus divaricatus	1

<i>Helianthus hirsutus</i>	3
<i>Juniperus virginiana</i>	2
<i>Lespedeza capitata</i>	4
<i>Lespedeza repens</i>	2
<i>Lespedeza virginica</i>	1
<i>Muhlenbergia sobolifera</i>	2
<i>Opuntia humifusa</i>	3
<i>Pellaea atropurpurea</i>	1
<i>Quercus prinoides</i>	3
<i>Rhus aromatica</i>	2
<i>Rhus glabra</i>	1
<i>Ruellia humilis</i>	1
<i>Saxifraga pensylvanica</i>	3
<i>Schizachyrium scoparium</i>	5
<i>Strophostyles leiosperma</i>	1
<i>Tragia species</i>	2
<i>Ulmus alata</i>	1

Glade 29

Bucker Gap #1 Glade

Location: R14W T17N Sec 17. At Bucker Gap.

<i>Acalypha gracilens</i>	4
<i>Andropogon gerardii</i>	3
<i>Antennaria plantaginifolia</i>	2
<i>Arenaria patula</i>	1
<i>Aster patens</i>	1
<i>Carya texana</i>	2
<i>Chamaecrista fasciculata</i>	2
<i>Coreopsis tinctora</i>	5
<i>Croton capitatus</i>	3
<i>Croton monanthogynus</i>	2
<i>Dicanthelium lanuginosum</i>	3
<i>Diodia teres</i>	3
<i>Diospyros virginiana</i>	1
<i>Euphorbia corollata</i>	2
<i>Fraxinus americana</i>	2
<i>Hedyotis longifolia</i>	2
<i>Helenium amarum</i>	2
<i>Helianthus hirsutus</i>	3
<i>Juniperus virginiana</i>	4
<i>Kummerowia striata</i>	3
<i>Lespedeza capitata</i>	3
<i>Opuntia humifusa</i>	3
<i>Quercus prinoides</i>	3
<i>Quercus stellata</i>	5
<i>Rhamnus caroliniana</i>	1
<i>Rhus copalina</i>	2
<i>Rhus glabra</i>	2
<i>Rudbeckia missouriensis</i>	4
<i>Ruellia humilis</i>	2
<i>Sabatia angularis</i>	2

Schizachyrium scoparium	5
Smilax bona-nox	3
Solidago nemoralis	2
Sorghastrum nutans	2
Ulmus alata	3
Vaccinium arboreum	2
Vitus species	2
Zizia aurea	2

Glade 30 Bucker Gap #2 Glade
 Location: R14W T17N Sec 17. At Bucker Gap.

Acalypha gracilens	5
Coreopsis tinctora	3
Dicanthelium lanuginosum	2
Opuntia humifusa	2
Quercus marilandica	3
Schizachyrium scoparium	5
Sedum pulchellum	3
Silene antirrhina	2
Talinum calycinum	1
Ulmus alata	4

Glade 31 Tyler Bend #1 Glade
 Location: R17W T15N Sec 2. Along hiking trail south
 of Tyler Bend Nature Center.

Ambrosia artemisiifolia	3
Asclepias verticillata	3
Aster oblongifolius	3
Aster oolentangiensis	1
Aster patens	3
Calamintha arkansana	3
Celtis tenuifolia	2
Chionathes virginicus	2
Croton monanthogynus	2
Dalea purpurea	1
Eupatorium altissimum	2
Fraxinus americana	3
Helianthus hirsutus	4
Juniperus virginiana	4
Muhlenbergia sobolifera	1
Opuntia humifusa	3
Pellaea atropurpurea	2
Quercus prinoides	3
Quercus stellata	3
Rhus aromatica	1
Rhus glabra	1
Schizachyrium scoparium	5
Solidago nemoralis	2
Solidago ulmifolia	2

<i>Sporobolus vaginiflorus</i>	5
<i>Tephrosia virginiana</i>	3
<i>Ulmus alata</i>	3
<i>Vaccinium arboreum</i>	1

Glade 32 Tyler Bend #2 Glade
 Location: R17W T15N Sec 2. West slope overlooking
 Calf Creek.

<i>Amelanchier arborea</i>	2
<i>Andropogon gerardii</i>	2
<i>Aster novae-angliae</i>	2
<i>Carex species</i>	2
<i>Carya texana</i>	1
<i>Celtis tenuifolia</i>	3
<i>Cercis canadensis</i>	2
<i>Cornus florida</i>	1
<i>Desmanthus illinoensis</i>	3
<i>Echinacea pallida</i>	4
<i>Eupatorium altissimum</i>	2
<i>Euphorbia corollata</i>	3
<i>Fraxinus americana</i>	3
<i>Gaura longiflora</i>	1
<i>Heliaathus hirsutus</i>	4
<i>Juniperus virginiana</i>	5
<i>Lespedeza capitata</i>	1
<i>Liatris squarrosa</i>	2
<i>Lithospermum canescens</i>	1
<i>Parthenium integrifolium</i>	2
<i>Quercus prinoides</i>	2
<i>Quercus stellata</i>	3
<i>Rhamnus caroliniana</i>	2
<i>Rudbeckia missouriensis</i>	4
<i>Sanicula odorata</i>	2
<i>Sassifras albidum</i>	2
<i>Schizachyrium scoparium</i>	5
<i>Smilax bona-nox</i>	2
<i>Solidago nemoralis</i>	4
<i>Solidago ulmifolia</i>	2
<i>Symphocarpus orbiculatus</i>	2
<i>Tephrosia virginiana</i>	3
<i>Toxicodendron radicans</i>	2
<i>Tridens flavus</i>	1
<i>Ulmus alata</i>	3
<i>Vaccinium pallidum</i>	1
<i>Viburnum rufidulum</i>	2

Glade 33 Tyler Bend #3 Glade
 Location: R17W T15N Sec 2. West slope, east of Buck
 Point Hollow and above hiking trail.

Asclepias verticillata	1
Aster oblongifolius	4
Bumelia lanuginosa	2
Calamintha arkansana	2
Carya glabra	1
Cercis canadensis	2
Dalea purpurea	3
Desmanthus illinoensis	3
Dicanthelium lanuginosum	2
Diodia teres	2
Eupatorium altissimum	3
Euphorbia corollata	2
Fraxinus americana	3
Hedyotis nigricans	4
Juniperus virginiana	3
Rhus aromatica	2
Rudbeckia missouriensis	5
Silphium terebinthinaceum	2
Smilax bona-nox	2
Sporobolus vaginiflorus	5
Tridens flavus	1
Vernonia arkansana	2

Glade 34

Brush Creek Glade

Location: R14W T17N Sec 15. Atop bluff north of Brush Creek.

Acalypha gracilens	2
Andropogon gerardii	4
Aster oblongifolius	2
Baptisia bracteata	1
Bumelia lanuginosa	3
Carya glabra	4
Carya texana	2
Chamaecrista fasciculata	1
Coreopsis tinctora	3
Croton monanthogynus	1
Dicanthelium lanuginosum	2
Fraxinus americana	1
Hedyotis longifolia	3
Helianthus hirsutus	3
Juniperus virginiana	2
Lespedeza virginica	3
Pinus echinata	4
Quercus stellata	3
Rhamnus caroliniana	1
Rhus copalina	2
Rubus species	1
Schizachyrium scoparium	5
Sporobolus vaginiflorus	5
Tephrosia virginiana	2

Ulmus alata

3

Glade 35

Bear Hollow #1 Glade

Location: R14W T17N Sec 22. Atop bluff north of Bear Hollow.

Andropogon gerardii	5
Aster oblongifolius	2
Bouteloua curtipendula	3
Croton monanthogynus	1
Dalea purpurea	2
Desmanthus illinoensis	3
Diospyros virginiana	2
Echinacea pallida	3
Eupatorium altissimum	4
Euphorbia corollata	1
Fraxinus americana	1
Galactia regularis	1
Hedyotis longifolia	2
Hedyotis nigricans	3
Lespedeza virginica	2
Liatris squarrosa	2
Manfreda virginica	2
Passiflora lutea	1
Pellaea atropurpurea	1
Quercus prinoides	3
Quercus rubra	1
Quercus stellata	4
Rhus aromatica	2
Rhus copalina	1
Ruellia humilis	1
Schizachyrium scoparium	5
Silphium laciniatum	2
Smilax bona-nox	4
Smilax glauca	1
Solidago nemoralis	1
Stylosanthes biflora	1
Tephrosia virginiana	2
Ulmus alata	3
Viburnum rufidulum	3

Glade 36

Bear Hollow #2 Glade

Location: R14W T17N Sec 21. Atop the bluff at the head of Bear Hollow.

Acalypha gracilens	2
Ambrosia artemisiifolia	1
Andropogon gerardii	5
Aster oblongifolius	2
Bumelia lanuginosa	1
Chamaecrista fasciculata	1

Chionathes virginicus	2
Coreopsis tinctora	5
Dicanthelium lanuginosum	3
Diodia teres	3
Elymus canadensis	1
Fraxinus americana	2
Helianthus hirsutus	1
Hypericum gentianoides	3
Juniperus virginiana	2
Quercus marilandica	1
Quercus stellata	1
Rhus copalina	1
Ruellia humilis	1
Schizachyrium scoparium	5
Sporobolus vaginiflorus	4
Stylosanthes biflora	3
Talinum calycinum	3
Ulmus alata	3
Unknown 43	1
Vaccinium arboreum	3

Glade 37 Bear Hollow #3 Glade
 Location: R14W T17N Sec 21. North of Glade 36 and
 north of the bluff at the head of Bear Hollow.

Acalypha gracilens	5
Ambrosia artemisiifolia	3
Andropogon gerardii	3
Antennaria plantaginifolia	3
Bumelia lanuginosa	2
Chamaecrista fasciculata	2
Coreopsis tinctora	3
Desmanthus illinoensis	1
Dicanthelium lanuginosum	3
Echinacea pallida	3
Euphorbia corollata	1
Hedyotis longifolia	1
Helianthus hirsutus	2
Juniperus virginiana	2
Palafoxia callosa	2
Pinus echinata	1
Quercus stellata	4
Rhus aromatica	2
Rhus copalina	1
Rhynchospora capillacea	2
Ruellia humilis	2
Schizachyrium scoparium	5
Schrankia nuttallii	1
Smilax bona-nox	1
Solidago nemoralis	1
Sporobolus neglectus	2

Sporobolus vaginiflorus	3
Tephrosia virginiana	3
Ulmus alata	3

Glade 38 Spencer Ridge Glade
 Location: R14W T17N Sec 15. Southwest side of
 Spencer Ridge.

Acalypha gracilens	2
Ambrosia artemisiifolia	2
Andropogon gerardii	5
Antennaria plantaginifolia	1
Asclepias viridiflora	1
Aster oblongifolius	1
Bouteloua curtipendula	4
Bumelia lanuginosa	1
Carya texana	3
Celtis tenuifolia	1
Cercis canadensis	1
Chamaecrista fasciculata	1
Commelina erecta	1
Coreopsis tinctora	4
Croton monanthogynus	2
Dalea candida	1
Dalea purpurea	2
Desmodium species	1
Diodia teres	1
Elymus canadensis	1
Erigeron strigosus	1
Eupatorium altissimum	2
Fraxinus americana	2
Grindelia lanceolata	3
Hedyotis longifolia	2
Helianthus hirsutus	3
Juniperus virginiana	3
Lespedeza virginica	1
Muhlenbergia capillaris	1
Opuntia humifusa	1
Palafoxia callosa	3
Pellaea atropurpurea	1
Quercus marilandica	1
Quercus stellata	5
Rhus aromatica	2
Ruellia humilis	1
Saxifraga pensylvanica	1
Schizachyrium scoparium	5
Schrankia nuttallii	1
Silphium laciniatum	1
Smilax rotundifolia	1
Solidago nemoralis	2
Solidago ulmifolia	1

<i>Sporobolus vaginiflorus</i>	4
<i>Talinum calycinum</i>	2
<i>Tragia species</i>	1
<i>Ulmus alata</i>	3
Unknown 43	3
<i>Verbesina helianthoides</i>	1

Glade 39 Bear Bluff North Glade
Location: R14W T17N Sec 23. Atop upstream end of
Bear Bluff.

<i>Andropogon gerardii</i>	4
<i>Antennaria plantaginifolia</i>	1
<i>Baptisia bracteata</i>	2
<i>Carya texana</i>	3
<i>Chamaecrista fasciculata</i>	3
<i>Coreopsis palmata</i>	1
<i>Echinacea pallida</i>	3
<i>Elymus canadensis</i>	2
<i>Helianthus hirsutus</i>	2
<i>Juniperus virginiana</i>	1
<i>Lespedeza virginica</i>	2
<i>Pinus echinata</i>	1
<i>Quercus rubra</i>	1
<i>Quercus stellata</i>	4
<i>Rhus aromatica</i>	5
<i>Schizachyrium scoparium</i>	5
<i>Tephrosia virginiana</i>	4
<i>Toxicodendron radicans</i>	2
<i>Ulmus alata</i>	1
<i>Vernonia baldwinii</i>	1

Glade 40 Bear Bluff South Glade
Location: R14W T17N Sec 23. Along old road at
downstream end of Bear Bluff.

<i>Acalypha gracilens</i>	3
<i>Ambrosia artemisiifolia</i>	2
<i>Andropogon gerardii</i>	5
<i>Aster novae-angliae</i>	1
<i>Aster oblongifolius</i>	1
<i>Aster pilosus</i>	1
<i>Bouteloua curtipendula</i>	3
<i>Bumelia lanuginosa</i>	3
<i>Campsis radicans</i>	2
<i>Carya texana</i>	2
<i>Celtis tenuifolia</i>	3
<i>Cercis canadensis</i>	1
<i>Commelina erecta</i>	1
<i>Coreopsis tinctora</i>	4
<i>Crataegus species</i>	1

<i>Dalea purpurea</i>	1
<i>Desmanthus illinoensis</i>	2
<i>Dicanthelium lanuginosum</i>	2
<i>Diodia teres</i>	3
<i>Diospyros virginiana</i>	3
<i>Echinacea pallida</i>	2
<i>Elymus canadensis</i>	1
<i>Eupatorium altissimum</i>	2
<i>Fraxinus americana</i>	2
<i>Gleditsia triacanthos</i>	2
<i>Grindelia lanceolata</i>	2
<i>Hedyotis nigricans</i>	3
<i>Helianthus hirsutus</i>	3
<i>Hypericum gentianoides</i>	2
<i>Juniperus ashei</i>	1
<i>Lespedeza cuneata</i>	3
<i>Lespedeza repens</i>	1
<i>Lespedeza virginica</i>	1
<i>Liatris squarrosa</i>	1
<i>Opuntia humifusa</i>	1
<i>Palafoxia callosa</i>	3
<i>Pellaea atropurpurea</i>	1
<i>Phoradendron leucarpum</i>	1
<i>Pinus echinata</i>	1
<i>Quercus prinoides</i>	3
<i>Quercus rubra</i>	1
<i>Quercus stellata</i>	3
<i>Rhus aromatica</i>	2
<i>Rhus copalina</i>	1
<i>Rhus glabra</i>	2
<i>Rudbeckia missouriensis</i>	3
<i>Ruellia humilis</i>	1
<i>Schizachyrium scoparium</i>	5
<i>Schrankia nuttallii</i>	1
<i>Silphium laciniatum</i>	1
<i>Smilax bona-nox</i>	3
<i>Smilax glauca</i>	1
<i>Solidago nemoralis</i>	1
<i>Sporobolus vaginiflorus</i>	3
<i>Ulmus alata</i>	3
Unknown 43	1
<i>Vaccinium arboreum</i>	2
<i>Verbesina helianthoides</i>	2
<i>Yucca glauca</i>	2
<i>Zizia aptera</i>	2

Glade 41

Cook Creek Glade

Location: R14W T18N Sec 34. South of Cook Creek.

<i>Andropogon gerardii</i>	3
<i>Antennaria plantaginifolia</i>	1

<i>Arenaria patula</i>	3
<i>Aster pilosus</i>	1
<i>Bumelia lanuginosa</i>	1
<i>Carya glabra</i>	1
<i>Carya texana</i>	1
<i>Celtis tenuifolia</i>	2
<i>Cercis canadensis</i>	1
<i>Coreopsis lanceolata</i>	1
<i>Croton capitatus</i>	1
<i>Croton monanthogynus</i>	1
<i>Dalea candida</i>	1
<i>Dalea purpurea</i>	1
<i>Echinacea pallida</i>	1
<i>Eupatorium altissimum</i>	1
<i>Fraxinus americana</i>	2
<i>Hedyotis nigricans</i>	3
<i>Helianthus hirsutus</i>	3
<i>Juniperus virginiana</i>	5
<i>Lespedeza virginica</i>	1
<i>Liatris squarrosa</i>	1
<i>Lithospermum canescens</i>	1
<i>Manfreda virginica</i>	1
<i>Monarda fistulosa</i>	2
<i>Opuntia humifusa</i>	1
<i>Quercus prinoides</i>	1
<i>Quercus stellata</i>	4
<i>Rhamnus caroliniana</i>	1
<i>Rhus aromatica</i>	2
<i>Rudbeckia missouriensis</i>	3
<i>Ruellia humilis</i>	1
<i>Saxifraga pensylvanica</i>	1
<i>Schizachyrium scoparium</i>	5
<i>Schrankia nuttallii</i>	1
<i>Smilax bona-nox</i>	1
<i>Solidago nemoralis</i>	1
<i>Sporobolus vaginiflorus</i>	4
<i>Toxicodendron radicans</i>	2
<i>Ulmus alata</i>	3
<i>Viburnum rufidulum</i>	1

Glade 42 Stair Bluff Point #1 Glade
 Location: R14W T18N Sec 26. Atop the last pinnacle
 of Stair Bluff.

<i>Andropogon gerardii</i>	5
<i>Asclepias verticillata</i>	1
<i>Asclepias viridiflora</i>	2
<i>Aster oblongifolius</i>	3
<i>Astragalus distortus</i>	2
<i>Bouteloua curtipendula</i>	5
<i>Bumelia lanuginosa</i>	1

<i>Celtis tenuifolia</i>	3
<i>Chionathes virginicus</i>	3
<i>Cornus drummondii</i>	1
<i>Croton monanthogynus</i>	2
<i>Dalea purpurea</i>	2
<i>Desmanthus illinoensis</i>	4
<i>Dicanthelium lanuginosum</i>	2
<i>Diospyros virginiana</i>	4
<i>Eupatorium altissimum</i>	1
<i>Glandularia canadensis</i>	1
<i>Hedyotis longifolia</i>	3
<i>Helianthus hirsutus</i>	1
<i>Juniperus virginiana</i>	1
<i>Lespedeza capitata</i>	1
<i>Lespedeza virginica</i>	3
<i>Opuntia humifusa</i>	1
<i>Palafoxia callosa</i>	4
<i>Ptelea trifoliata</i>	4
<i>Quercus prinoides</i>	2
<i>Rhus aromatica</i>	2
<i>Rhus glabra</i>	2
<i>Schizachyrium scoparium</i>	3
<i>Smilax bona-nox</i>	1
<i>Solidago nemoralis</i>	4
<i>Symphocarpus orbiculatus</i>	2
<i>Ulmus alata</i>	1
Unknown 45	1

Glade 43 Stair Bluff Point #2 Glade
 Location: R14W T18N Sec 26. Atop the lower point
 of Stair Bluff, just south of Glade 42.

<i>Andropogon gerardii</i>	3
<i>Aster oblongifolius</i>	2
<i>Bouteloua curtipendula</i>	3
<i>Celtis tenuifolia</i>	1
<i>Croton monanthogynus</i>	3
<i>Desmanthus illinoensis</i>	4
<i>Diospyros virginiana</i>	3
<i>Eupatorium altissimum</i>	2
<i>Galactia regularis</i>	2
<i>Helianthus hirsutus</i>	1
<i>Juniperus virginiana</i>	1
<i>Manfreda virginica</i>	1
<i>Palafoxia callosa</i>	3
<i>Ptelea trifoliata</i>	1
<i>Quercus prinoides</i>	1
<i>Rhus glabra</i>	2
<i>Saxifraga pensylvanica</i>	2
<i>Schizachyrium scoparium</i>	4
<i>Schrankia nuttallii</i>	2

Smilax bona-nox	1
Solidago nemoralis	3
Unknown 46	5

Appendix D: Management recommendations for glades of the
Buffalo National River

Following is a list of locations, site descriptions, problems, and management recommendations for each glade studied. Because many fewer glades were found in the upper and middle districts than in the lower district, and because fewer high quality glades were found in the upper and middle districts, I had less latitude in choosing glades in these two districts to preserve. Therefore management recommendations have been made for glades in the upper and middle districts which may not have been made had these same glades been located in the lower district. Additionally, when a glade was located near a hiking trail or otherwise in a position to be seen by the public, more consideration was given toward management techniques to preserve and to improve the site.

Glade 1 (Pruitt)

This glade has a sandstone substrate at lower elevations and a limestone substrate at upper elevations. A road forms the lower, south and west boundary of the glade, while it grades into oak-hickory forest along the upper, north and east edge. The glade has a limited diversity probably due to a history of grazing. The remains of a fence still run the

length of the site.

Pruitt Glade is located across the river from Pruitt Ranger Station and is less than 0.8 km (0.5 mi) from Highway 7. The upper elevations of the site suffer heavily from the invasion of eastern red cedar (Juniperus virginiana). Many species listed for this site are no longer evident in these invaded areas. Lower areas where sandstone substrate is located are open due to the absence of soil. This area is kept bare by erosion. Rainfall and water from higher elevations wash the calcium binder from the sandstone, leaving behind amorphous pieces of sand without structure to hold them together. What looks like pieces of sandstone crumble to pure sand particles. The sand washes down the slope to the roadway below.

Assets: The glade's location and easy access by road make it suitable for public use and examination.

Problems: The degraded condition of the glade and lack of many species make it a poor example of the region's glade communities.

Recommendations: To maintain most of this glade, the cutting of many of the cedars will be necessary. If cutting is not done, the only part of this glade that will be maintained in an open condition is the bare rock sandstone where erosion maintains the open character of the site. Many species now present would no longer be represented if cutting were not done.

If feasible, this site might be used by park naturalists as a resource to educate campers, canoeists, and other public users of the Pruitt area.

Glade 2 (Grapevine Ridge #1)

This glade has a sandstone substrate at lower elevations and a limestone substrate at upper elevations. A road forms the lower, south and west boundary of the glade while it grades into oak-hickory forest along the upper, north and east edge. The glade has a limited diversity probably due to a history of grazing.

Grapevine Ridge Glade #1 is located less than 1.6 km (1.0 mi) from Highway 7 and on the same road as Pruitt Glade. The upper elevations of the site suffer heavily from the invasion of eastern red cedar. Many species listed for this site are no longer evident in these invaded areas. Lower areas where sandstone substrate is located are open due to the absence of soil. The same factors influencing Pruitt Glade also influence this site.

Assets: The glade's location and easy access by road make it suitable for public use and examination.

Problems: The degraded condition of the glade and lack of many species make it a poor example of the region's glade communities.

Recommendations: To maintain most of this glade, the

cutting of many of the cedars will be necessary. If cutting is not done, the only part of this glade which will maintain in an open condition is the bare rock sandstone where erosion maintains the open character of the site. Many species now present would no longer be represented if cutting were not done.

Glade 3 (Grapevine Ridge #2)

This glade has a sandstone substrate at lower elevations and a limestone substrate at upper elevations. A road forms the lower, south and west boundary of the glade while it grades into oak-hickory forest along the upper, north and east edge. The glade has a limited diversity probably due to a history of grazing.

Grapevine Ridge Glade #2 is located less than 2.4 km (1.5 mi) from Highway 7 and on the same road as Pruitt Glade and Grapevine Ridge #1. The glade extends beyond the NPS boundary and onto private property on the north. The upper elevations of the site suffer heavily from the invasion of eastern red cedar. Many species listed for this site are no longer evident in these invaded areas. Lower areas where sandstone substrate is located are open due to the absence of soil. The same factors influencing Pruitt Glade and Grapevine Ridge #1 also influence this site.

Assets: The glade's location and easy access by road make

it suitable for public use and examination.

Problems: The degraded condition of the glade and lack of many species make it a poor example of the region's glade communities. Encouragement of public use of this site could result in trespass problems for the owners of nearby private property.

Recommendations: To maintain most of this glade, the cutting of many of the cedars will be necessary. If cutting is not done, the only part of this glade which will maintain in an open condition is the bare rock sandstone where erosion maintains the open character of the site. Many species now present would no longer be represented if cutting were not done.

Glade 4 (Grapevine Ridge #3)

This glade has a sandstone substrate at lower elevations and a limestone substrate at upper elevations. A road forms the lower, south and east boundary of the glade while oak-hickory forest forms the upper, north and west boundary. The glade has a limited diversity probably due to a history of grazing.

Grapevine Ridge Glade #3 is located approximately 1.6 km (1.0 mi) from Highway 7 and on the same road as Pruitt Glade and Grapevine Ridge #1 and #2. The site suffers from the invasion of eastern red cedar. Many species listed for this

site are no longer evident in these invaded areas.

Assets: The glade's location and easy access by road make it suitable for public use and examination.

Problems: The degraded condition of the glade and lack of many species make it a poor example of the region's glade communities.

Recommendations: To maintain most of this glade, the cutting of many of the cedars will be necessary. Many species now present would no longer be represented if cutting were not done.

Glade 5 (Ozark)

This site is a small bare rock sandstone glade with an outcrop of limestone at the top (northwestern) edge. It is located along the Buffalo River Trail between Ozark and Pruitt. The trail passes through the sandstone portion of the glade.

Assets: Being along a major hiking trail, this site has the opportunity of being seen by many people.

Problems: This glade is small and has low diversity.

Recommendations: This glade could be maintained by controlled burning. It is small enough not to require much labor in burning. The site could also be improved through seeding with native glade species. Although a small site, it is in a position to be observed and appreciated by many individuals.

Glade 6 (Steel Creek #1)

This site is on a southwest facing slope along the Buffalo River Trail east of Steel Creek and the Steel Creek Ranger Office. The substrate is limestone. The site is suffering from invasion by several woody species, resulting in the appearance of several small remnants rather than of one glade.

Assets: This glade is located along a trail which potentially allows it to be seen by many individuals.

Problems: The site has few glade species and many forest species.

Recommendations: Management would require the cutting of larger trees and controlled burn. Although a site for possible reclamation, it is one of the poorer sites.

Glade 7 (Steel Creek #2)

This site is a moderately steep, small glade located at an overlook along the Buffalo River Trail east of Steel Creek. The substrate is limestone. Much of the glade is a point of bare rock. The glade is heavily invaded with sweet clover (Melolotus alba).

Assets: This site is used by many people due to its location on the trail and as a scenic overlook of the Steel Creek valley.

Problems: The site is very small, invaded by non-native species, and not floristically significant.

Recommendations: This site is not recommended for management as a glade.

Glade 8 (Steel Creek #3)

This site is a very steep, bluff glade overlooking the Buffalo River downstream from Steel Creek. The substrate is limestone. Its open characteristic and lack of woody invasion is maintained by continuous erosion. The Buffalo River Trail passes along the upper margin of this glade.

Assets: The site is located along a major hiking trail. Due to its location and steepness, the site is very impressive and provides a good view of the valley.

Problems: Its steepness makes management of the site difficult.

Recommendations: The glade should be self-maintaining due to the high erosional rate of the site. It is recommended that nothing be done to this site.

Glade 9 (Beech Creek)

This site is a moderately steep, west southwest facing slope overlooking Beech Creek below the Buffalo River Trail. While suffering from a heavy encroachment of woody species, the

site was formerly of good size and still holds a diverse community of glade species. The largest remaining area is a flatrock sandstone glade. Above and to the north of the flatrock area, several glade remnants with a limestone substrate remain.

Assets: This site's potentially large size, its location along a major hiking trail, its combination of flatrock sandstone and limestone substrates, and its innate beauty make this site a potentially valuable glade for restoration. This glade is probably the best example of a glade community found in the upper and middle sections of the riverway.

Problems: The site is heavily invaded with woody species. In addition, although the site is easily reached by foot it is located at a distance and across steep terrain from vehicular access.

Recommendations: It is recommended that a combination of cutting of trees and controlled burning be used to restore this site, which is unique in the upper river area.

Glades 10 & 11 (Adair Cemetery #1 & #2)

These sites are flatrock sandstone glades with a large percentage of bare rock and lichen, a small grass component and a surrounding xeric blackjack oak (Quercus marilandica) woody component. The two glades are separated from one another by a ravine. They lie below a gravel road which leads from Highway

7 to the Erbie area. Due to the massive sandstone substrate of these glades, they appear to be very stable communities.

Assets: Ease of access to the sites, their close proximity to one another, and their inherent stability are major positive factors.

Problems: Neither site is floristically diverse. Many glade species are not present and no glade species were found in the surrounding forest edges.

Recommendations: Since both glades are probably stable, it is recommended that no action be taken to manage them at this time.

Glade 12 (Chestnut Cabin)

This site is located east of Chestnut Cabin on a flat shelf at an altitude of 459 m (1505 ft) on Newberry Point of Gaither Mountain. It is bordered on the south by the road which leads to Chestnut Cabin, where this road stops running up the mountain and turns left to circle it. This road is closed to the public. On the north the site is bounded by a very vertical and woody part of Newberry Point.

The site was the only glade found upon Undifferentiated Upper Mississippian strata. Its close proximity to Chestnut Cabin, its rectangular shape, and the presence of an old fence at the western edge of the glade suggest that the site was used as a native pasture and possibly hayfield. This use may have

resulted in the area remaining open and unforested. Although presently undergoing an invasion of eastern red cedar, it still contains a strong component of native grasses.

Assets: The site has a unique substrate. Access to it by road would make management easier.

Problems: None.

Recommendations: It is recommended that the cedar be removed from this site by cutting and that the area be burned in a controlled manner to stimulate the growth of herbaceous species.

Glade 13 (Ludlow Bluff #1)

This site is a long, thin strip of blufftop glade with a southwest aspect located within the Lower Buffalo Wilderness. The substrate is limestone. It is fairly diverse with only slight woody invasion.

Assets: Due to its steepness and location at the edge of Ludlow Bluff, the site probably remains open and stable through erosional processes.

Problems: Like all glades within the Lower Wilderness, access to the site is difficult.

Recommendations: It is not felt that this site requires management.

Glade 14 (Ludlow Bluff #2)

Located at a lower elevation and to the west of Ludlow Bluff #1 Glade, this site is a large flatrock sandstone, part of which is covered with limestone colluvial material (rocks and soil). It suffers little from woody invasion and is probably stable owing to the shallowness to the massive sandstone substrate. This glade contains one species (Amsonia ciliata) which was found in no other glade in Buffalo National River.

Assets: This site is unique owing to its floristic nature.

Problems: This site can only be reached by descending 90 m (300 ft) of a very steep slope.

Recommendations: Although changes upon this site should be monitored, it is felt that the glade is stable and does not require management at this time.

Glade 15 (Ingram Hollow)

Located upon limestone over sandstone, this glade occupies the south and west faces of a point overlooking a branch of Ingram Hollow. It is on private property east and north of Tea Table Glade. The site has a good component of glade plants and is only slightly encroached with woody species.

Assets:

Cons: On private property.

Recommendations: This is not a unique or major site and should not be of concern.

Glade 16 (Tea Table)

This site is located atop a saddle ridge leading to Devil's Tea Table Rock. It is formed upon thin limestone atop massive sandstone substrate. The lack of depth to sandstone is the primary reason for the presence of this glade. It contains a healthy grass component and is moderately encroached by eastern red cedar and Ashe's juniper (Juniperus ashei). Also found was Chionanthus virginica, a woody species not often found on glades in the area.

Assets: This is a fairly large glade. The presence of Ashe's juniper makes it an important site.

Problems: Although the closeness to sandstone bedrock has kept this location open, it is in danger of being overgrown by Juniperus spp.

Recommendations: It is recommended that this site be very closely monitored, perhaps on an annual basis, for short term changes in floristic composition and woody expansion.

Glade 17 (Peter Hollow)

This site is a flatrock sandstone glade overlooking Highway 14 and the Dillard's Ferry access point. As is the case

with many flatrock sites, it lacks any important grass component and is not undergoing a woody invasion. The site is lacking in soil except along the western edge, and is mostly bare rock, mosses, and lichens. Also found here was an endemic grasshopper with coloration adapted to blend with the sandstone and mosses.

Assets: This is a stable site with easy access. It contains a potentially rare animal species.

Problems: None.

Recommendations: No management need be taken except to protect the site from disturbance. Although access to the site is not difficult, it is not in a location where many people will find it if they do not know of its existence.

Glade 18 (Coon Hollow)

This site is not so much a glade as a collection of glade remnants. Although aerial photographs taken in the 1970's show an open site, the site is no longer open except for a collection of very small separated pockets of grasses with a few glade species. It is located at the end of a point west of the road leading to a camping area at the mouth of Coon Creek. The substrate is limestone.

Assets: Easy access.

Problems: The site is overgrown by forest.

Recommendations: It is recommended that no attempt be

made to restore this site.

Glades 19, 20, & 21 (Warner Bluff #1, #2, & #3)

These sites form a complex of glades at different elevations of the middle knob of Warner Bluff. Glades encircle the knob, but are most well developed on the south and west aspects and on the saddle between this knob and the more western knob. The middle knob is encircled by rock outcroppings, cliffs, and karst features. These factors and the large size of the three glades result in this location being unique in the Buffalo National River. While much of the area is in stable condition, woody encroachment is a factor in some parts. The complex contains a diverse number of species.

Glade 19, the lowest, is on sandstone substrate, Glade 20 is limestone, and Glade 21, the highest, is also on limestone.

Access to the sites is difficult as no passable roads come close to the area. Best access is from private land to the south and requires a long hike over rugged terrain. Roads which approach from the south might be driven by four wheel drive vehicles.

Assets: These sites are a large unique complex of glades which have a relatively high species diversity and a great natural beauty.

Problems: The remoteness of the location will make management difficult.

Recommendations: It is recommended that the area be monitored annually for changes in species composition and woody encroachment, and that the sites be managed by controlled burning if necessary.

Glade 22 (Silver Hollow)

This site is a small flatrock sandstone glade with a northeastern aspect in the "duck's head" of the Lower Wilderness area. Located at the edge of a bluff, it is mostly bare rock with a very limited glade species component and no grass component. Access to the site is from a trail atop Ludlow Bluff. The site is probably kept open due to erosion by the runoff from the slope above.

Assets: The site is probably stable.

Problems: This blufftop glade is very small and has a depauperate species composition.

Recommendations: It is recommended that no management of this site be undertaken.

Glade 23 (Toney Bend)

This site is located on a northwest facing slope above the upstream end of Ludlow Bluff. The site appears to have been much larger at one time but is now limited to the steeper portions of the location. Although the remaining areas are

invaded with several woody species, the site is still fairly diverse. The substrate is sandstone. Unlike many of the sandstone sites, soil has formed at this location. This fact may be due to colluvial material from further up slope. Access to the site is down a steep slope from a trail atop Ludlow Bluff.

Assets: Fairly good species diversity.

Problems: The location is difficult to access and would be difficult to manage though controlled burning or tree removal due to surrounding forest and slope.

Recommendations: It is recommended that no management be attempted at this location.

Glade 24 (Fishtrap Hollow East)

This site is a very large flatrock sandstone glade on private property south of Warner Bluff near the lower riverway. It is the largest glade that has been found along the Buffalo River. It is bisected by a road which is now accessible only to four wheel drive vehicles. While much of the glade is bare rock, some of it is soil covered and is dominated by a grass. Species diversity is moderate. Woody invasion is slight and restricted to limited areas.

Assets: This site is a very large, intact glade.

Problems: The glade is not within the riverway.

Recommendations: It is recommended that Arkansas Natural

Heritage consider purchasing this site or otherwise seeing to its preservation. While not floristically unique, the glade's large size makes the site impressive and worthy of protection.

Glade 25 (Warner Bluff #4)

This site is a remnant glade on the northwest slope of the first knob of Warner Bluff. The substrate is limestone. Access is from a trail above the site, which is a continuation of the trail bisecting glade 24. This small glade has a grass component and a strong component of glade species. Woody invasion within the remnant is slight; however, the site is surrounded by forest.

Assets:

Problems: The site is small and remote. Also it might be difficult to manage due to the surrounding forest and the inability to access the site without crossing private property.

Recommendations: This is probably not an important site and no management is recommended.

Glade 26 (Granite Mtn.)

This site is a west slope remnant glade on limestone substrate. It overlooks Cook Creek on the eastern knob of Granite Mountain in the Lower Buffalo Wilderness. Access is from an overgrown trail along the top of the mountain. The

site is moderately to heavily invaded by woody species.

It is possible that this glade remnant is actually a remnant of a large savanna area which covered the south slopes of Turkey and Hathaway Mountains and the lower north slope of Granite Mountain.

Assets:

Problems: The site is small and remote.

Recommendations: A survey of the neighboring savanna area may show this site to have relationship with that savanna. It is recommended that no actions be taken concerning this site until the savanna survey is completed.

Glade 27 (Cow Creek #1)

This site occupies a saddle ridge and south facing blufftop in the Lower Buffalo Wilderness south of Cow Creek and west of Fox Den Spring. The substrate is a thin limestone derived soil over massive sandstone strata. The saddle area has decreased in size since the National River was created due to an invasion of blackjack oak (Q. marilandica). The bluff edge appears to be a much more stable area and extends for approximately 30 meters to either side of the saddle. Access to the site is fairly easy from a trail to the west, which turns and passes just north and below the glade.

Assets: This site is more easily accessed by foot than most glades within the lower wilderness.

Problems:

Recommendations: Controlled burning is recommended to remove encroaching blackjack oaks.

Glade 28 (Cow Creek #2)

This site is located east of Cow Creek #1 Glade on a knob south of the trail leading into Cow Creek. Its substrate is limestone. This site is the largest remaining remnant of a chain of remnant glades which run up the knob. It is not large enough to contain many trees, although one may assume that woody invasion has resulted in much of the surrounding forest. The site itself contains several woodland forbs and is without a full complement of glade species.

Assets:

Problems: This site is difficult to access and is not floristically an intact glade.

Recommendations: It is not recommended that restoration of this site be attempted.

Glade 29 (Bucker Gap #1)

This site is located on the north side of the Buffalo River in the Lower Buffalo Wilderness. Access to the glade may be had by a former road, now trail, which runs from the northern boundary of the wilderness and along the eastern edge

of the glade. The site is the largest glade found within the Buffalo National Riverway. The substrate is shallow limestone over sandstone. A small portion of the site is occupied by a sandstone outcropping upon which is found a flatrock glade community. The primary aspect of the site is west facing.

This extensive site has many open areas of quality glade. However, other parts are heavily invaded by post oak (Q. stellata), eastern red cedar, chinquapin oak (Q. prinoides), and winged elm (Ulmus alata). Along the old roadway the site has been invaded by Korean lespedeza (Lespedeza striata), which is probably indicative of its use as a route for hauling hay from bottomland fields to the south. Also, it is possible that cattle were wintered on this glade. Fortunately, exotic species do not seem to have established elsewhere within the glade.

Assets: This is a very large and interesting site worthy of further study and preservation.

Problems: Although a trail runs directly to the site, it is several miles by foot from the trailhead. Much of the site will not remain as glade without management.

Recommendations: It is recommended that this site be managed by controlled burning and possibly by cutting of some trees. Access to the site by boat from Horseshoe Bend may prove a better way than the trail of getting men and equipment to the location.

Glade 30 (Bucker Gap #2)

This site is a flatrock sandstone glade separated from Bucker Gap #1 Glade by forest. It lies south of Buckner Gap #1 along the old road. This site is the only sandstone glade in the area which is crossed by linear fissures from which trees grow. The site has very few species.

Assets: The site is stable due to the massive character of the substrate. The unique fissures and its close proximity to Buckner Gap #1 are probably its most positive characteristics.

Problems: The site has low species diversity.

Recommendations: Controlled burning of Buckner Gap #1 might easily be extended to Bucker Gap #2 without much effort. However, one would expect only the margins of Buckner Gap #2 to burn since very little litter accumulation takes place on flatrock sites.

Glades 31, 32, & 33 (Tyler Bend #1, #2, & #3)

These three sites are the only glades located in the middle river management area. They are located along hiking trails around the Tyler Bend Nature Center. Substrates are limestone. All three sites are small. Tyler Bend #1 and #3 are talus slopes with considerable bare rock. Tyler Bend #2 is primarily grass covered; however, it is very steep and is probably maintained by erosion. The forest component at Tyler

Bend #2 is more important than at the other two sites. All three sites are found on west facing slopes and have been maintained by erosion rather than by fire.

If these three sites were located elsewhere on the riverway or if other glades had been located in this area, then these three sites would not be of any particular importance. However, they are the only glades found on the riverway for 96 river kilometers (60 river miles). That fact combined with their close proximity to the nature center at Tyler Bend make them potentially valuable as teaching tools for naturalists at Tyler Bend.

Although small, the sites do contain several species which probably cannot be found in the surrounding woodlands and oldfields which comprise the area.

Assets: The sites' location near Tyler Bend and beside hiking trails make these areas potentially valuable educational resources for naturalist presentations. Due to their steep locations the sites are probably self-maintaining.

Problems: The sites are not very good examples of glades, being small and atypical of glades in other parts of the riverway.

Recommendations: These sites should be used as educational tools by naturalists at Tyler Bend. Management should be maintained.

Glade 34 (Brush Creek)

This site is a small blufftop glade located on the south slope of a spur ridge at the head of Brush Creek. Access is from a hiking trail to the northeast. The substrate is sandstone. The species composition is fairly depauperate with many woodland species in evidence.

The location was originally chosen for exploration by the author because a large area of open ground was identified on the topographic map. Almost all of the area so identified is in young forest today and no evidence of glade species or grasses is evident there. The only exceptions to this are two tiny (10 X 10 m) glade remnants at the western point of the spur ridge. It is thought that the opening identified on the topographic map is of agricultural origin and was not originally a glade.

Assets: As is the case with most blufftop glades, this one is probably very stable.

Problems: This site has a very poor species composition for a glade.

Recommendations: No management recommendations are made for this site.

Glade 35 (Bear Hollow #1)

This site is a blufftop glade which extends down a very

steep slope from oak hickory forest above to a precipice below. Its extent to the left and right is indeterminate, with trees and brush dissecting the glade into many small remnants. Although time did not allow a complete exploration, it is probable that small blufftop glades extend completely around Bear Hollow. Access to the site is from a trail passing above the location.

Although fairly overgrown with woody and woodland species, the open portions of the site are probably self-maintaining due to erosion. The component of glade species is well represented.

The substrate is limestone. The bluff below is probably capped by sandstone although this could not be ascertained due to inaccessability of the strata.

Assets: This site is probably self-maintaining.

Problems: The site's steepness make exploration and management of the site very difficult.

Recommendations: Management of this site is probably not necessary, and no management is recommended.

Glade 36 (Bear Hollow #2)

This site is located at the head of Bear Hollow on massive sandstone substrate with a bluff below and oak-hickory forest above. Access to the site is from the Rose Ridge trail above. With the exception of Fishtrap Hollow Glade (on private

property) this site is the largest sandstone glade surveyed along the Buffalo River. The aspect of this glade varies as it wraps around the head of the hollow from almost north facing through east facing to south facing.

The upper portions of this site possess a thin colluvial soil while the lower portions are bare rock. The site is most probably maintained by erosion. Woody invasion is not a problem at this site. Grasses dominate the upper portion of the site, while mosses, lichens, and bare rock dominate the lower portion. In spite of this variation, the diversity of the site is limited.

Assets: This is a large sandstone glade. It is probably stable.

Problems: The site has low diversity.

Recommendations: Management of this site is probably not necessary. Long term observation of the site would be valuable.

Glade 37 (Bear Hollow #3)

This site is located on the south facing slope above Bear Hollow #2 Glade. It is identified as a different glade because it is formed upon a different substrate, being limestone over the massive sandstone. Access is from the Rose Ridge trail above the glade.

The grass component of the site is much more dominant than

that of Bear Hollow #2. Also, the upper portion of this site is being invaded by a nearly pure stand of small (2.5-5.0 cm dbh) post oak.

Assets: The location of this site directly above Bear Hollow #2 Glade makes it valuable for comparing the dynamics of limestone and sandstone glades.

Problems: The site is located deep within the Lower Buffalo Wilderness making access difficult.

Recommendations: Further study of this site is recommended, followed by controlled burning and removal of the small post oaks to preserve and restore the site. Long term observation of the site is recommended.

Glade 38 (Spencer Ridge)

The site is located on the southwest side of the trail which runs the length of Spencer Ridge. Access is from the trail. The substrate is limestone. The slope is moderately steep and ends at a bluff. A diverse component of glade species is present. Post oak and some cedar are invading the site.

Assets: This site is visible from the Spencer Ridge trail and is potentially seen by all users of the trail. It has a healthy glade component.

Problems: As is the case with all sites north of the river in the southern part of the lower wilderness, it is a long

walk to this site. Also, woody invasion is a problem.

Recommendations: Due to its relatively high visibility, it is recommended that controlled burning and possibly cutting of larger trees be undertaken to restore the site. Once restored, this glade will be seen and appreciated by more users of the Lower Buffalo Wilderness than any other large glade in that area.

Glade 39 (Bear Bluff North)

This site is a small triangular glade sitting atop an outcrop of sandstone at the north end of Bear Bluff in the Lower Buffalo Wilderness. Access is from the Spencer Ridge trail above. Its aspect is northwest. The upper boundary is oak-hickory-pine forest. The lower boundaries are bluff.

The site is not large and does not have a large component of glade species. The site is heavily invaded by post oak, black hickory (Carua texana), and fragrant sumac (Rhus aromatica).

Assets:

Problems: The site is very small and floristically insignificant.

Recommendations: No management is recommended for this site.

Glade 40 (Bear Bluff South)

This site occupies a triangular section at the south end of Bear Bluff. Its aspect is south. Its substrate is sandstone. The glade is very steep and occupies two levels separated by a six meter bluff. The two levels are connected by an old road, which forms the southern end of the present day Spencer Ridge trail.

This site is very diverse, although the edges are being encroached upon by several tree species. The steepness of the site results in erosion being an important factor here. The western portions of the site grade into Bear Bluff.

Assets: This site is a fairly large, diverse glade.

Problems: The site is one of the most remote in the riverway.

Recommendations: Controlled burning is recommended to rejuvenate the site and remove potentially invasive woody species. Access to the site might be made by boat downstream from Bear Bluff.

Glade 41 (Cook Creek)

This site lies at the base of the north slope of Granite Mountain along the Cook Hollow trail. Access is by this trail. The substrate is limestone. This site is located at a much lower elevation than any other glade found in the lower

wilderness. The site has only a limited glade component and is heavily invaded by eastern red cedar, post oak, and winged elm.

The site is probably a remnant of the savanna which occupies the south slope of Turkey and Hathaway Mountains and which lies just across Cook Hollow Creek.

Assets: Access is relatively easy owing to the Cook Hollow trail and the closeness to the trailhead at Hathaway Hollow.

Problems: The site is not very diverse and is heavily invaded by woody species. The site is probably a portion of Turkey Mountain Savanna.

Recommendations: It is recommended that no action be taken at this site until a complete study of Turkey Mountain Savanna has been completed.

Glade 42 (Stair Bluff Point #1)

This tiny glade is located atop the last point of Stair Bluff. The site is at the terminus of the trail which extends up the back side of Stair Bluff. This is the point where the metal cross has been constructed. The substrate is the cap of sandstone which tops all of the peaks of Turkey Mountain and Stair Bluff. Soil is thin and slopes to bare rock in all directions from approximately the center of the cap.

Diversity is moderate but very good for such a small site. Almost all woody invasion is at the edge of the site and probably results from trees rooting in the limestone below the

GLADE SITES NEEDING BURNING (IN RELATIVE PRIORITY ORDER)

GLADE #	NAME	LOCATION	COMMENTS
29	BUCKER GAP 40 AC	S17, T17N, R14W	REMOTE; LARGEST GLADE IN PARK; INVASION BY BLACKJACK OAK, RED CEDAR, CHINQUAPIN OAK, WINGED ELM. ADJACENT #30 MAY BENEFIT FROM BURNING.
9	BEECH CREEK WILDERNESS 30 X 20; 0.15 AC.	S16, T16N, R22W	LARGE SIZE; HEAVY ENCROACHMENT BY WOODY SPECIES.
12	CHESTNUT CABIN 100 X 60; 1.5 AC.	S29, T17N, R21W	INVASION BY RED CEDARS.
27	COW CREEK #1 WILDERNESS 80 X 30; 0.6 AC.	S9, T17N, R14W	ENCROACHING BLACKJACK OAK.
40	BEAR BLUFF SOUTH WILDERNESS 100 X 50; 1.24 AC.	S23, T17N, R14W	LARGE, DIVERSE GLADE; MOST REMOTE IN PARK.
38	SPENCER RIDGE WILDERNESS 95 X 20; 0.47 AC.	S15, T17N, R14W	HIGH VISIBILITY TO LOWER WILDERNESS USERS.
5	OZARK 20 X 8; 0.04 AC.	S12, T16N, R21W	SMALL SIZE; TRAIL ACCESS FROM OZARK.
37	BEAR HOLLOW #3 WILDERNESS 80 X 20; 0.4 AC.	S21, T17N, R14W	FURTHER STUDY RECOMMENDED, THEN BURNING IN FUTURE

SUMMARY OF GLADE MANAGEMENT RECOMMENDATIONS

GLADE #	NAME IN WILDERNESS? SIZE: METERS & AC.	STRATA	EST. ACTION PRIORITY	NEEDS					COMMENTS
		S=SANDSTONE L=LIMESTONE	H=HIGH M=MODERATE L=LOW	NONE	CUT	BURN	MONITOR	OTHER	
1	PRUITT GLADE 310 X 16; 1.22 AC.	S/L	L TO M		X				EASY ACCESS/PRUITT
2	GRAPEVINE RIDGE #1 50 X 20; 0.25 AC.	S/L	M		X				
3	GRAPEVINE RIDGE #2 100 X 35; 0.86 AC.	S/L	L TO M		X				CONTINUES ONTO PRIVATE LAND DEGRADED CONDITION POOR SPECIES DIVERSITY
4	GRAPEVINE RIDGE #3	S/L	M		X				DEGRADED CONDITION POOR SPECIES DIVERSITY
5	OZARK 20 X 8; 0.04 AC.	S/L	M		SOME	X		X	"OTHER" - POSSIBLY SEED W/NATIVE GRASS SPECIES; ON OZARK- PRUITT TRAIL
6	STEEL CREEK #1 WILDERNESS	L	L TO M		X	X			
7	STEEL CREEK #2 WILDERNESS	L	NONE	X					NOT RECOMMENDED FOR MGT. AS GLADE-VERY SMALL, NON-NATIVE SPECIES

8	STEEL CREEK #3 WILDERNESS	L	NONE	X					
9	BEECH CREEK WILDERNESS 30 X 20; 0.15 AC.	S	H		X	X			LARGE SIZE & UNIQUE IN UPPER & MIDDLE DISTRICTS
10	ADAIR CEMETERY #1	S	NONE	X					
11	ADAIR CEMETERY #2 115 X 30; 0.78 AC.	S	NONE	X					
12	CHESTNUT CABIN 100 X 60; 1.5 AC.	L	M TO H		X	X			STRONG COMPONENT OF NATIVE GRASSES
13	LUDLOW BLUFF #1 WILDERNESS 30 DIA.; 0.2 AC.	L	NONE	X					

10	ADAIR CEMETERY #1	S	NONE	A					
11	ADAIR CEMETERY #2 115 X 30; 0.78 AC.	S	NONE	X					
12	CHESTNUT CABIN 100 X 60; 1.5 AC.	L	M TO H		X	X			STRONG COMPONENT OF NATIVE GRASSES
13	LUDLOW BLUFF #1 WILDERNESS 30 DIA.; 0.2 AC.	L	NONE	X					
14	LUDLOW BLUFF #2 WILDERNESS	S/L	M				X		ONLY GLADE TO CONTAIN "AMSONIA CILIATA"
15	INGRAM HOLLOW PRIVATE PROPERTY 50 X 25; 0.3 AC.	S/L	NONE	X				X	ON PRIVATE PROPERTY
16	TEA TABLE WILDERNESS 280 X 40; 2.76 AC.	S	M TO H				X(ANN.)		ASHES JUNIPER PRESENT, LARGE SIZE GLADE
17	PETER HOLLOW 83 X 89; 1.83 AC.	S	M					X	"OTHER"-PROTECT FROM DISTURBANCE; POTENTIALLY RARE GRASSHOPPER SPECIES
18	COON HOLLOW	S	NONE	X					REMNANTS ONLY

19	WARNER BLUFF #1 WILDERNESS	S	M			X (AS NEED)	X		#19,20 & 21 ARE ALL OF LARGE SIZE & COMPLEX GEOLOGY; LENGTHY ACCESS
20	WARNER BLUFF #2 WILDERNESS	L	M			X (AS NEED)	X		
21	WARNER BLUFF #3 WILDERNESS	L	M			X (AS NEED)	X		
22	SILVER HOLLOW WILDERNESS 12 X 25; 0.07 AC.	S	NONE	X					LOW SPECIES DIVERSITY
23	TONEY BEND WILDERNESS 50 X 20; 0.25 AC.	L	NONE	X					
24	FISHTRAP HOLLOW/E WILDERNESS	S	NONE					X	"OTHER"-PRESERVE VIA PRIVATE GROUP; ON PRIVATE PROPERTY
25	WARNER BLUFF #4 WILDERNESS 25 X 20; 0.12 AC.	L	NONE	X					ACCESS ACROSS PRIVATE PROPERTY

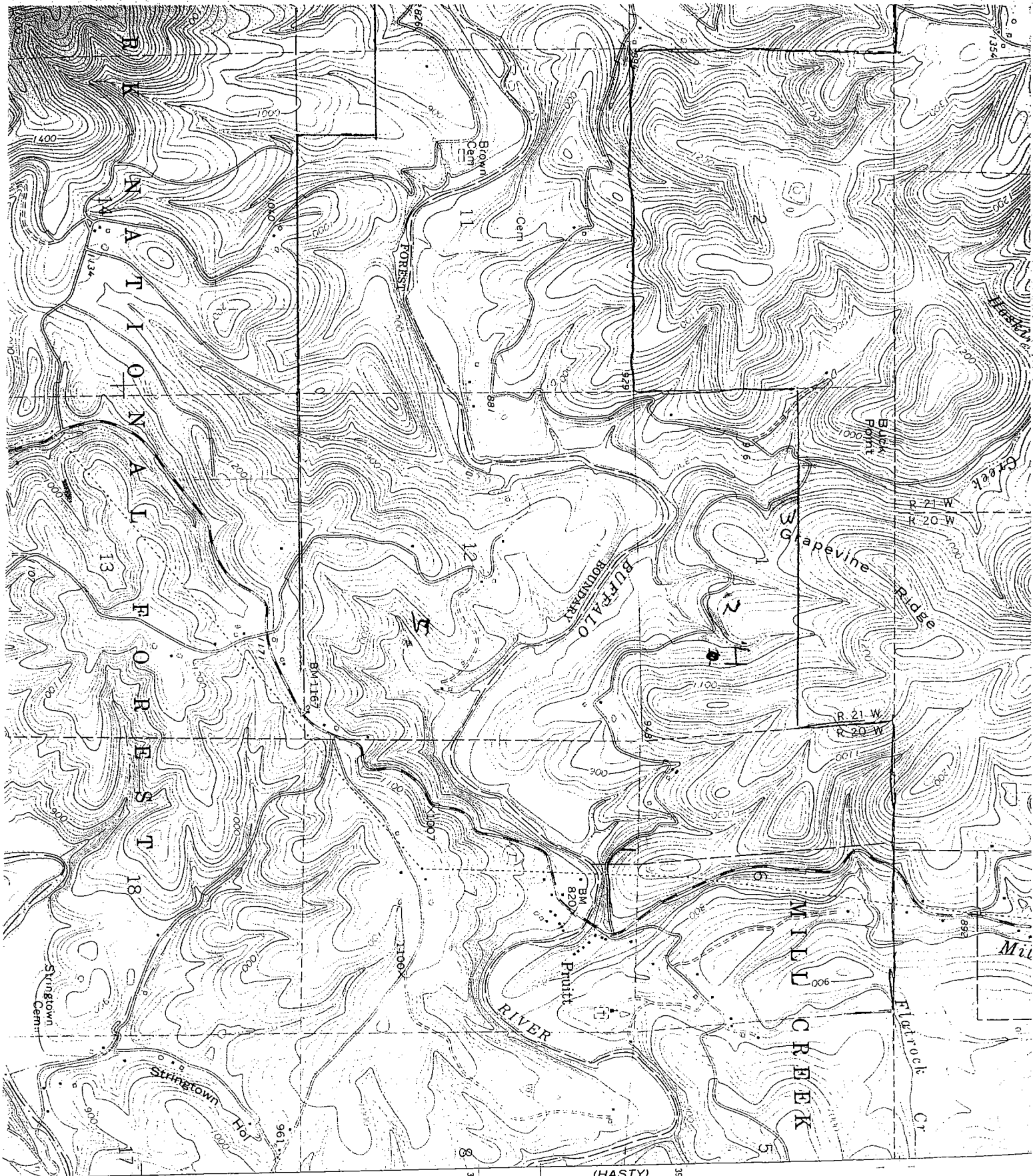
19	WARNER BLUFF #1 WILDERNESS	S	M			X (AS NEED)	X		#19,20 & 21 ARE ALL OF LARGE SIZE & COMPLEX GEOLOGY; LENGTHY ACCESS
20	WARNER BLUFF #2 WILDERNESS	L	M			X (AS NEED)	X		
21	WARNER BLUFF #3 WILDERNESS	L	M			X (AS NEED)	X		
22	SILVER HOLLOW WILDERNESS 12 X 25; 0.07 AC.	S	NONE	X					LOW SPECIES DIVERSITY
23	TONEY BEND WILDERNESS 50 X 20; 0.25 AC.	L	NONE	X					
24	FISHTRAP HOLLOW/E WILDERNESS	S	NONE					X	"OTHER"-PRESERVE VIA PRIVATE GROUP; ON PRIVATE PROPERTY
25	WARNER BLUFF #4 WILDERNESS 25 X 20; 0.12 AC.	L	NONE	X					ACCESS ACROSS PRIVATE PROPERTY
26	GRANITE MTN. WILDERNESS 40 X 25; 0.25 AC.	L	NONE					X	"OTHER"-COMPLETE SAVANNAH STUDY
27	COW CREEK #1 WILDERNESS 80 X 30; 0.6 AC.	L	M			X			INVASION BY BLACKJACK OAK
28	COW CREEK #2 WILDERNESS 12 X 12; 0.03 AC.	L	NONE	X					

29	BUCKER GAP #1 WILDERNESS 440 X 370; 40.2 AC	L	HIGH		X-SOME	X			LARGEST IN PARK
30	BUCKER GAP #2 WILDERNESS 50 X 35; 0.43 AC.	S	M		X	X			ADJACENT TO #29
31	TYLER BEND #1 30 X 25; 0.18 AC.	L	NONE	X					"OTHER"-SURVEY MIDDLE DISTRICT FOR BETTER EXAMPLES OF GLADES

	WILDERNESS 40 X 25; 0.25 AC.								
27	COW CREEK #1 WILDERNESS 80 X 30; 0.6 AC.	L	M			X			INVASION BY BLACKJACK OAK
28	COW CREEK #2 WILDERNESS 12 X 12; 0.03 AC.	L	NONE	X					

29	BUCKER GAP #1 WILDERNESS 440 X 370; 40.2 AC	L	HIGH		X-SOME	X			LARGEST IN PARK
30	BUCKER GAP #2 WILDERNESS 50 X 35; 0.43 AC.	S	M		X	X			ADJACENT TO #29
31	TYLER BEND #1 30 X 25; 0.18 AC.	L	NONE	X					"OTHER"-SURVEY MIDDLE DISTRICT FOR BETTER EXAMPLES OF GLADES
32	TYLER BEND #2 25 X 20; 0.12 AC.	L	NONE	X					
33	TYLER BEND #3 10 X 25; 0.06 AC.	L	NONE	X					
34	BRUSH CREEK WILDERNESS 35 X 10; 0.08 AC.	L	NONE	X					
35	BEAR HOLLOW #1 WILDERNESS 15 DIA.; 0.05 AC.	S	NONE	X					DISAGREES WITH SIZE OF ADJACENT GLADES; ASSUME THE 15M IS WIDTH, NOT DIAMETER; GLADE RUNS FOR 30- 100 M.
36	BEAR HOLLOW #2 WILDERNESS 300 X 45; 3.33 AC.	S	M				X	X	"OTHER"-LONG TERM OBSERVATION OF SITE, COMPARE #37, LARGEST SANDSTONE GLADE
37	BEAR HOLLOW #3 WILDERNESS 80 X 20; 0.4 AC.	L	M			X- FUTURE	X	X	"OTHER"-FURTHER STUDY, FOLLOWED BY BURNING

38	SPENCER RIDGE WILDERNESS 95 X 20; 0.47 AC.	L	L TO M		X-SOME	X			RELATIVELY HIGH VISIBILITY TO WILDERNESS USERS
39	BEAR BLUFF NORTH WILDERNESS 30 X 15; 0.11 AC.	L	NONE	X					
40	BEAR BLUFF SOUTH WILDERNESS 100 X 50; 1.24 AC.	S	L TO M			X			VERY DIVERSE; REMOTE ACCESS
41	COOK CREEK WILDERNESS 50 X 25; 0.31 AC.	L	NONE	X				X	"OTHER"-COMPLETE SAVANNAH STUDY
42	STAIR BLUFF #1 WILDERNESS 13 DIA.; 0.04 AC.	S	NONE	X					FIRE MIGHT INCREASE EROSION
43	STAIR BLUFF #2 WILDERNESS 8 DIA.; 0.01 AC.	S	NONE	X					



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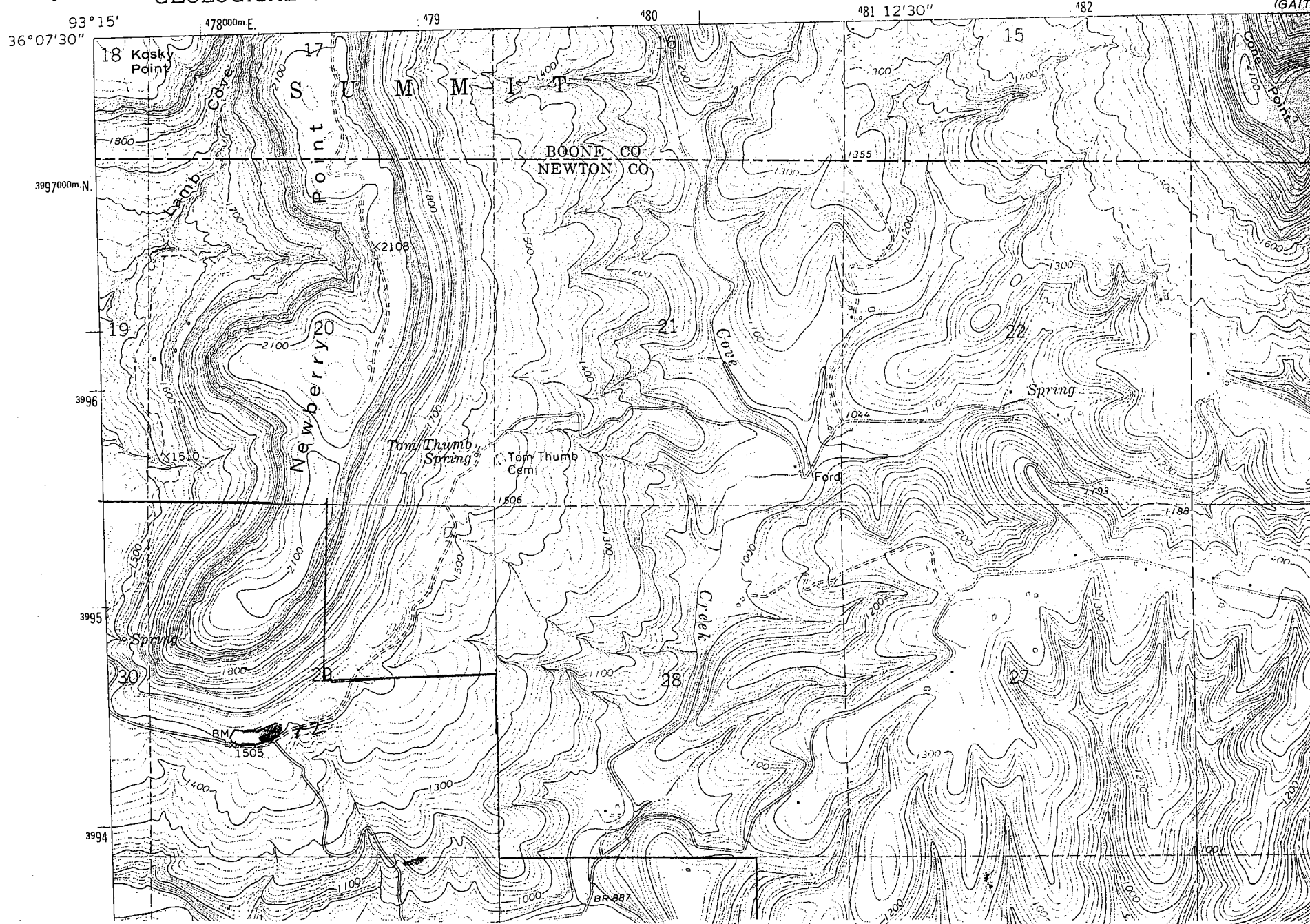
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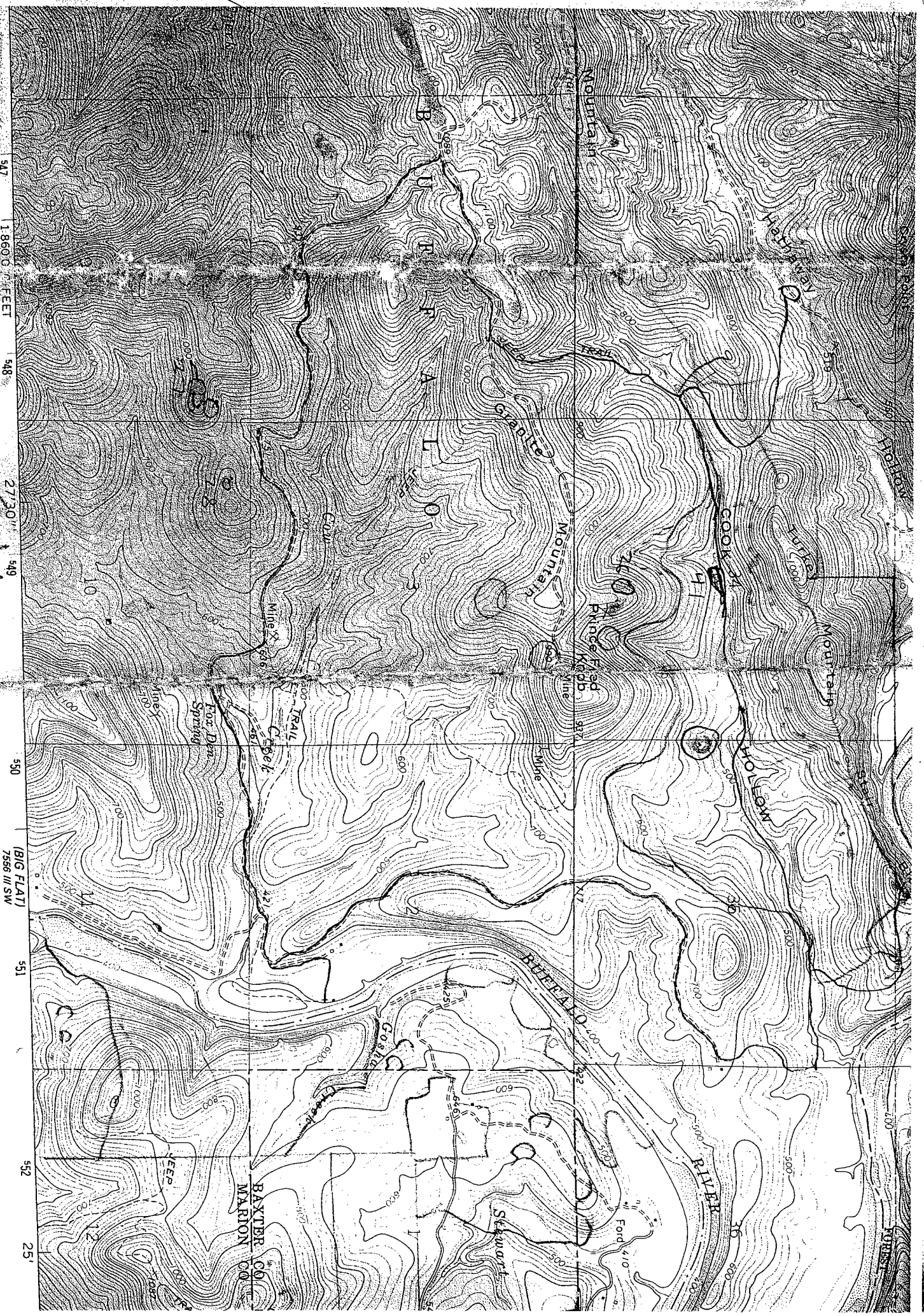
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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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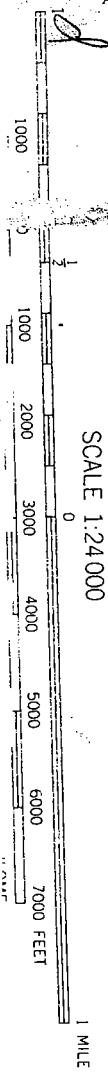




Geological Survey

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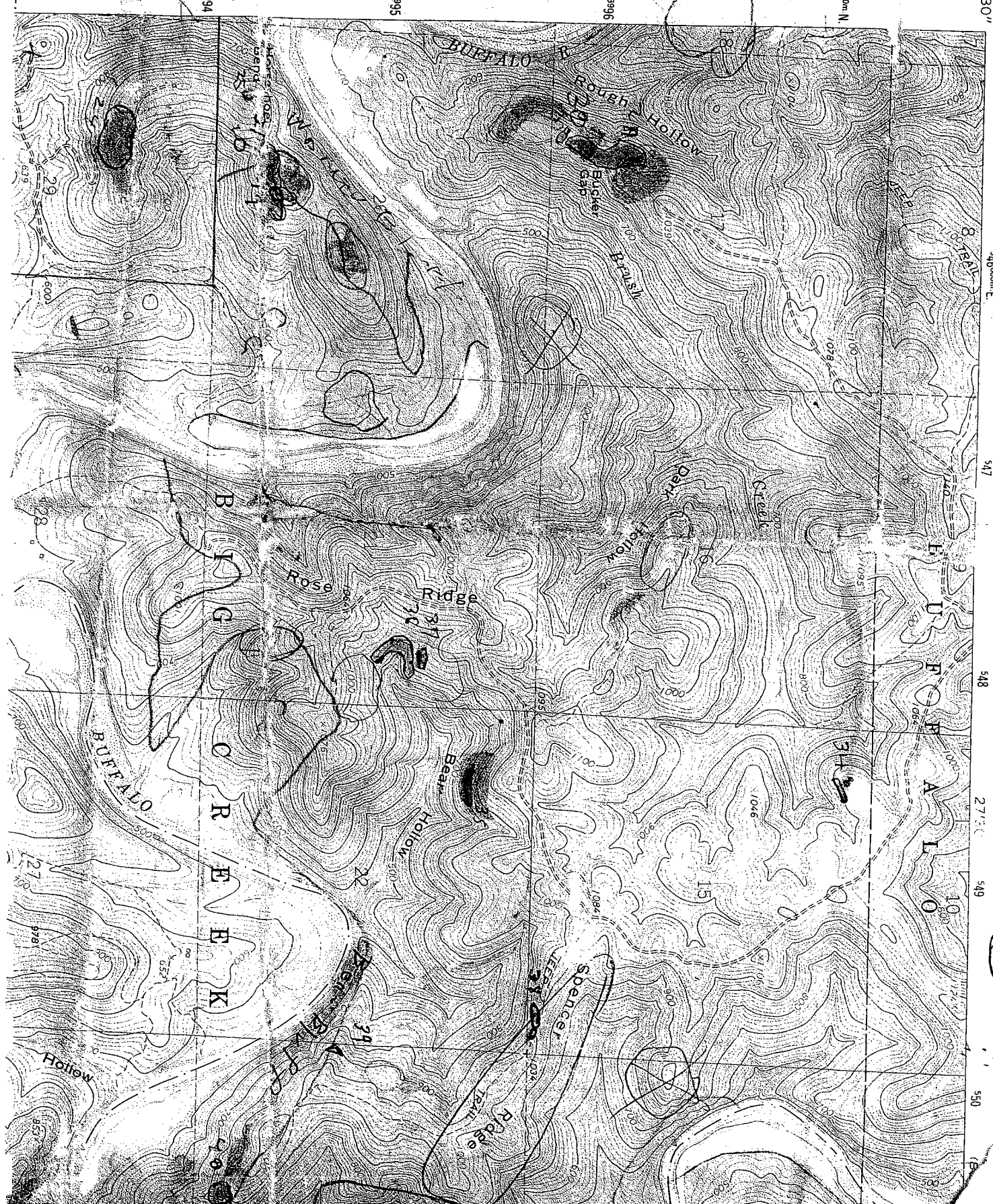
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Glade 37 (Bear Hollow #3)

S21, T17N, R14W .4AC

This site is located on the south facing slope above Bear Hollow #2 Glade. It is identified as a different glade because it is formed upon a different substrate, being limestone over the massive sandstone. Access is from the Rose Ridge trail above the glade.

The grass component of the site is much more dominant than that of Bear Hollow #2. Also, the upper portion of this site is being invaded by a nearly pure stand of small (2.5-5.0 cm dbh) post oak.

Assets: The location of this site directly above Bear Hollow #2 Glade makes it valuable for comparing the dynamics of limestone and sandstone glades.

Problems: The site is located deep within the Lower Buffalo Wilderness making access difficult.

Recommendations: Further study of this site is recommended, followed by controlled burning and removal of the small post oaks to preserve and restore the site. Long term observation of the site is recommended.

Glade 36 (Bear Hollow #2)

This site is located at the head of Bear Hollow on massive sandstone substrate with a bluff below and oak-hickory forest above. Access to the site is from the Rose Ridge trail above. With the exception of Fishtrap Hollow Glade (on private

Glade 5 (Ozark)

512, T16N, R21W

.04AC

This site is a small bare rock sandstone glade with an outcrop of limestone at the top (northwestern) edge. It is located along the Buffalo River Trail between Ozark and Pruitt. The trail passes through the sandstone portion of the glade.

Assets: Being along a major hiking trail, this site has the opportunity of being seen by many people.

Problems: This glade is small and has low diversity.

Recommendations: This glade could be maintained by controlled burning. It is small enough not to require much labor in burning. The site could also be improved through seeding with native glade species. Although a small site, it is in a position to be observed and appreciated by many individuals.

Glade 38 (Spencer Ridge)

S15, T17N, R14W .47AC

The site is located on the southwest site of the trail which runs the length of Spencer Ridge. Access is from the trail. The substrate is limestone. The slope is moderately steep and ends at a bluff. A diverse component of glade species is present. Post oak and some cedar are invading the site.

Assets: This site is visible from the Spencer Ridge trail and is potentially seen by all users of the trail. It has a healthy glade component.

Problems: As is the case with all sites north of the river in the southern part of the lower wilderness, it is a long walk to this site. Also, woody invasion is a problem.

Recommendations: Due to its relatively high visibility, it is recommended that controlled burning and possibly cutting of larger trees be undertaken to restore the site. Once restored, this glade will be seen and appreciated by more users of the Lower Buffalo Wilderness than any other large glade in that area.

S23, T17N, R14W 1.24Ac

Glade 40 (Bear Bluff South)

This site occupies a triangular section at the south end of Bear Bluff. Its aspect is south. Its substrate is sandstone. The glade is very steep and occupies two levels separated by a six meter bluff. The two levels are connected by an old road, which forms the southern end of the present day Spencer Ridge trail.

This site is very diverse, although the edges are being encroached upon by several tree species. The steepness of the site results in erosion being an important factor here. The western portions of the site grade into Bear Bluff.

Assets: This site is a fairly large, diverse glade.

Problems: The site is one of the most remote in the riverway.

Recommendations: Controlled burning is recommended to rejuvenate the site and remove potentially invasive woody species. Access to the site might be made by boat downstream from Bear Bluff.

Glade 27 (Cow Creek #1)

S 9, T 17 N, R 14 W .6 AC

This site occupies a saddle ridge and south facing blufftop in the Lower Buffalo Wilderness south of Cow Creek and west of Fox Den Spring. The substrate is a thin limestone derived soil over massive sandstone strata. The saddle area has decreased in size since the National River was created due to an invasion of blackjack oak (Q. marilandica). The bluff edge appears to be a much more stable area and extends for approximately 30 meters to either side of the saddle. Access to the site is fairly easy from a trail to the west, which turns and passes just north and below the glade.

Assets: This site is more easily accessed by foot than most glades within the lower wilderness.

Problems:

Recommendations: Controlled burning is recommended to remove encroaching blackjack oaks.

Glade 12 (Chestnut Cabin)

S29, T17N, R21W 1.5AC

This site is located east of Chestnut Cabin on a flat shelf at an altitude of 459 m (1505 ft) on Newberry Point of Gaither Mountain. It is bordered on the south by the road which leads to Chestnut Cabin, where this road stops running up the mountain and turns left to circle it. This road is closed to the public. On the north the site is bounded by a very vertical and woody part of Newberry Point.

The site was the only glade found upon Undifferentiated Upper Mississippian strata. Its close proximity to Chestnut Cabin, its rectangular shape, and the presence of an old fence at the western edge of the glade suggest that the site was used as a native pasture and possibly hayfield. This use may have resulted in the area remaining open and unforested. Although presently undergoing an invasion of eastern red cedar, it still contains a strong component of native grasses.

Assets: The site has a unique substrate. Access to it by road would make management easier.

Problems: None.

Recommendations: It is recommended that the cedar be removed from this site by cutting and that the area be burned in a controlled manner to stimulate the growth of herbaceous species.

Glade 9 (Beech Creek)

S16, T16N, R22W

.15 AC

This site is a moderately steep, west southwest facing slope overlooking Beech Creek below the Buffalo River Trail. While suffering from a heavy encroachment of woody species, the site was formerly of good size and still holds a diverse community of glade species. The largest remaining area is a flatrock sandstone glade. Above and to the north of the flatrock area, several glade remnants with a limestone substrate remain.

Assets: This site's potentially large size, its location along a major hiking trail, its combination of flatrock sandstone and limestone substrates, and its innate beauty make this site a potentially valuable glade for restoration. This glade is probably the best example of a glade community found in the upper and middle sections of the riverway.

Problems: The site is heavily invaded with woody species. In addition, although the site is easily reached by foot it is located at a distance and across steep terrain from vehicular access.

Recommendations: It is recommended that a combination of cutting of trees and controlled burning be used to restore this site, which is unique in the upper river area.

Glade 29 (Bucker Gap #1)

S17, T17N, R14W 40AC

This site is located on the north side of the Buffalo River in the Lower Buffalo Wilderness. Access to the glade may be had by a former road, now trail, which runs from the northern boundary of the wilderness and along the eastern edge of the glade. The site is the largest glade found within the Buffalo National Riverway. The substrate is shallow limestone over sandstone. A small portion of the site is occupied by a sandstone outcropping upon which is found a flatrock glade community. The primary aspect of the site is west facing.

This extensive site has many open areas of quality glade. However, other parts are heavily invaded by post oak (Q. stellata), eastern red cedar, chinquapin oak (Q. prinoides), and winged elm (Ulmus alata). Along the old roadway the site has been invaded by Korean lespedeza (Lespedeza striata), which is probably indicative of its use as a route for hauling hay from bottomland fields to the south. Also, it is possible that cattle were wintered on this glade. Fortunately, exotic species do not seem to have established elsewhere within the glade.

Assets: This is a very large and interesting site worthy of further study and preservation.

Problems: Although a trail runs directly to the site, it is several miles by foot from the trailhead. Much of the site will not remain as glade without management.

Recommendations: It is recommended that this site be managed by controlled burning and possibly by cutting of some trees. Access to the site by boat from Horseshoe Bend may prove a better way than the trail of getting men and equipment to the location.

Glade 30 (Bucker Gap #2)

This site is a flatrock sandstone glade separated from Bucker Gap #1 Glade by forest. It lies south of Buckner Gap #1 along the old road. This site is the only sandstone glade in the area which is crossed by linear fissures from which trees grow. The site has very few species.

Assets: The site is stable due to the massive character of the substrate. The unique fissures and its close proximity to Buckner Gap #1 are probably its most positive characteristics.

Problems: The site has low species diversity.

Recommendations: Controlled burning of Buckner Gap #1 might easily be extended to Bucker Gap #2 without much effort. However, one would expect only the margins of Buckner Gap #2 to burn since very little litter accumulation takes place on flatrock sites.

See note